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The Journal of the American Welding Society

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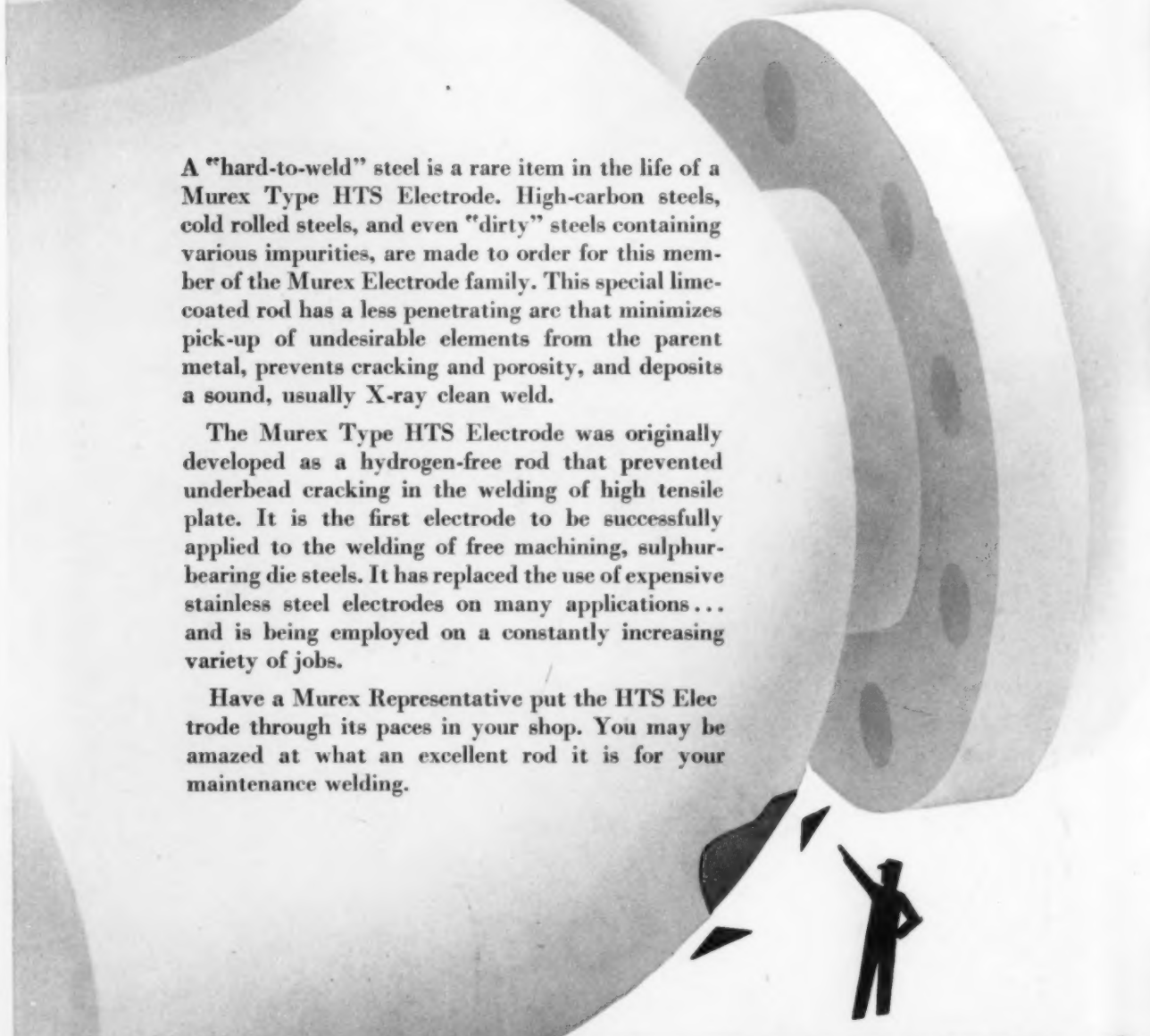

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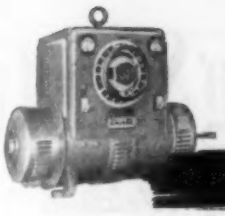

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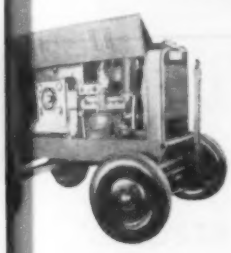

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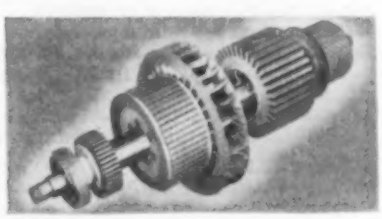

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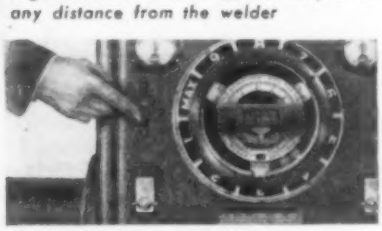

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The Journal of the American Welding Society

Published for the Advancement of the Science and Art of Welding

W. SPRARAGEN, Editor

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COVER

Arc Welding a Cluster Joint of a Towing Carriage at the Plant of C. Frederick Wolse Co. *Courtesy Air Reduction Sales Co.*

ISSUED MONTHLY

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The Journal of The American Welding Society

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The Office of Naval Research*

By Vice-Admiral H. G. Bowen, U.S.N.

THE Office of Naval Research was established in May 1946 by order of the Secretary of the Navy and in August 1946 became a permanent Naval office by Act of Congress.

The aim of the Office of Naval Research is primarily to stimulate and coordinate basic research in Naval laboratories, and, next, to encourage Naval sponsorship of extra-governmental research. These aims may, at first glance, seem incongruous in a military organization dealing in ships and guns and fighting men. But closer analysis of them will demonstrate beyond dispute their complete practicality.

Military science in 1947 is no longer the study of the ingenious use of force through men and equipment. It has become rather the study of the ingenious application of physics, chemistry, psychology, and other sciences, with men and equipment acting as agents rather than originators. The finest fruit of our civilization—the trained mind—has found a key position in the last outpost of our barbarism, organized warfare. At the moment the ironies of this situation, and even the inherent dangers, are lost in the frightening welter of our struggle for survival but they exist and must some day be faced.

At the moment, however, the struggle for survival predominates the world picture, and the new epoch of military science demands new approaches. The Office of Naval Research is the Navy's answer to the challenge of modern warfare, offered not as a stimulant to conflict but as the most effective preventive: knowledge in reserve.

In World War II the Navy, as well as the Army, lacked basic knowledge in certain fields of science and for that reason alone encountered many wasteful, time-consuming difficulties in solving its operational problems. The atom bomb, it should be remembered, was made possible by research made primarily outside the armed forces and before the war. Under the pressure of high national danger this knowledge was collected, learned and applied, in time to prevent disaster. But such a perilous inadequacy in the fields of science and technology must never again be allowed to exist in the armed forces of this country—not if we expect to remain a free and sovereign nation. In the light of this interpretation, the task of the Office of Naval Research becomes increasingly important.

The development and application of Naval equipment and manpower, the training of Naval personnel remain, as before, in the competent hands of the Naval Bureaus. But the burden of responsibility for research rests heaviest on the Office of Naval Research.

The Navy seeks knowledge in all the sciences, not only for itself but also for the national security and the betterment of the national life. It is more interested in the fact of the existence of valuable research than in the specific location or allegiance of the researcher. In order to fulfill the requirements of such a quest, the Navy has broken through the barrier traditionally separating the civilian and military worlds and has established itself as an active participant in academic and industrial research. And it is backing this participation with 22 million dollars in research contracts.

A meeting such as this today is of great interest to the Office of Naval Research. Quite aside from the obvious pertinence of metallurgy and its sister sciences to an organization producing steel ships and weapons, such a meeting represents a deliberate pooling of basic knowledge and techniques for the benefit of all—including the Navy. The Navy, at this meeting, is no more and no less than any of you—it is a member, a contributor and a recipient. The principle of mutual assistance and combined effort in scientific research is one the Office of Naval Research strongly advocates. Indeed, the interdependence of all phases of our national life—civil and military—is a practical fact, upon the honest recognition of which depends our national future. The age of narrow specialization is giving place to an age of intellectual cooperation. The Office of Naval Research hopes to be among the vanguard of this revolution, with a progressive practical program of action.

In the initial stages of embarking upon a research program, serious consideration must be given to the choice of talents that should be used. Some 50 years ago this problem was simple. A man could rightfully be classified as a metallurgist, physicist, chemist or engineer, and he was able to follow all of the research in his chosen field as well as keep abreast of allied subjects. However, as the scientific fields advanced, sometimes with a vast accumulation of empirical data, it became more and more difficult and ultimately impossible for the scientist to keep abreast of all of the literature, and accordingly the scientific world found that new specialties were springing up, with men specializing in certain aspects of a given field. Thus, the chemist became a physical chemist, an organic chemist, a physical metallurgist or a welding engineer. Today the scientist tends to become even more specialized, so that we have men working in still smaller fields which require his full attention. For example, in metallurgy we have men who are experts in powder metallurgy, gas welding, arc welding, spot welding, tool steels, steel castings, etc. This is all an advance, of course, but we must realize that nature will not reduce the complexion of her secrets because the human mind has its limitations. It means that we must marshall all of our available talents to solve our problems. For most

* An address before the Joint Meeting of the American Society for Metals and the AMERICAN WELDING SOCIETY, Dec. 11, 1946, Washington, D. C.

of the problems of current interest, it is necessary to use the services of the metallurgist, the physicist, the engineer and the mathematician to obtain a satisfactory answer.

This meeting tonight is in some respects a manifestation of this outlook. Here the AMERICAN WELDING SOCIETY and the American Society of Metals have gathered for a joint meeting for the purpose of exchanging information. When I was Director of the Naval Research Laboratory, at which time I came to know quite a few of the members of this audience, I often found that many otherwise difficult problems were solved by being able to discuss them with scientists working in other fields.

These days the metallurgist must look deeply into his research for small clues that may lead to the development of new ideas and perhaps entirely new fields of endeavor. Those unexplained anomalies which occur so often may be the manifestation of phenomena which, if properly explored, may lead to very fruitful territory. We must be careful, however, never to screen an insufficiency of knowledge by audacious speculation and hypothesis. No matter how delightful your hypothesis may appear to you, unless firmly constructed the bubble will burst and disappear into thin air.

Theories must be built upon facts. Without facts theories are vain efforts. However, the mere accumulation of facts is often futile unless the inner secrets of their occurrence are probed to uncover the laws which govern them. Too often in our research are facts accumulated and placed in the scientific archives to gather dust until they are rescued and made to form the basis of a broad and general theory. The other nations of this world readily concede that the scientists of the United States are leaders in technological research. Only rarely, however, do they admit that they are leaders in fundamental or basic research. It is the job of all of us here to remedy this situation so that our leadership in science will be undeniably founded.

Upon examination of the metallurgical sciences, one does not have to go very far before he encounters a number of unanswered problems. When the welder strikes his arc at the beginning of his welding operation, how much can we tell him of the mechanism of the transfer of metal from the welding rod to the base metal or what can we tell him of the function of the rod coating? The transfer of metal during welding involves a complex process of ion migration and vaporization, all under a field of fairly large potential and in an atmosphere of an almost unknown composition. While we understand in a general way the behavior of the electrode coating as it affects the welded metal and its action in producing sound welds, we do not fully understand the influence of the coatings on the metal transfer by the arc. It is problems such as these that require the attention of physicists as well as that of the chemist and metallurgist.

One of the most difficult problems of the present day is the task of predicting the behavior of metals in service from laboratory and small-scale tests. After the metallurgist has completed his laboratory work on the weldability of a steel or the design of a new steel, what assurance does he have that a structural member made of that material or welded with that technique will give satisfactory performance? For a simple analysis, the usual procedure is to postulate the behavior of an infinitesimal region of the member under the general combination of forces and then, by applying the fundamental laws of physics to the problem for any given geometry under fixed or variable forces, the problem can be solved *in principle*. Two major problems arise, however; one is that even with simple assumptions as to the behavior of a material under applied forces, the mathematical methods available have succeeded in giving an exact solution only for cases where the geometry is quite simple; the other difficulty is that it is not at all clear what behavior should be postulated when the deformations are large and when plastic flow sets in. The introduction of plastic strain into the metal immediately introduces an anisotropy factor resulting from that strain. This departure from perfect isotropy must be taken into account in any problem of plastic deformation, especially those involving combined stresses. For those cases studied so far, that of small strains, this anisotropy is not great, but neither are the effects of combined stresses resulting from biaxial stresses. This problem remains unsolved for the cases of large plastic strains and triaxial stresses. For the biaxial stress cases, the shear-strain energy theory is a sufficient criterion for resistance to deformation for small strains. However, calculations using the shear-strain energy show that triaxial stresses have a great effect on the resistance to deformation. It should be noted that the problems involved in the field of triaxial stresses are practically untouched. In much the same way, plastic deformation tends to complicate the solution of those problems involving the determination of fracture strength. The problems in this field are many and practically untouched.

For the topic just covered, involving the behavior of metals under stress, it is generally assumed that the materials are metallurgically alike, that is, that one plate of a steel of a given chemical composition and heat treatment will behave in the same manner as a similarly treated plate. Those of you who were concerned with the behavior of ship plate on merchant vessels during the past war, know that steels can be very capricious. Plates of ostensibly the same chemical composition and heat treatment did not behave alike. The specification used during the war failed to screen the good plates from the bad, but the reasons for the variability of the plates have not as yet been uncovered. The metallurgical process involved in determining the over-all ductility or toughness apparently has escaped us. Apparently one must know the entire history of the material, starting back to the melting furnace on through to the heat treatment before this problem can be solved.

It is easily seen, then, that the research work concerned with the behavior of metals under stress is intimately connected with the metallurgical changes that occur during the deformation of the metal. There are many phenomena occurring on a microscopic scale which may be very important. For example, what precipitations are taking place while the metal is being plastically deformed? Under normal conditions, when a metal is deformed the solubility of such impurities as oxygen, nitrogen and also carbon, which are dissolved in the ferrite, is decreased and must precipitate from the ferrite. This precipitation will occur on the ship plates and change the critical shear strength of the individual crystals. Further, the amount and rate of precipitation will depend upon the amount of plastic strain and the temperature. The strain at which a metal will flow plastically is also complicated by the fact that the strain at which the load is applied is also an important factor. It is possible to apply a stress so fast that no plastic deformation will take place, even though the stress exceeds the normally determined yield point of the material; this shows that slip is time dependent, and this time element plays an important role in plastic deformation. Practically nothing is known about the critical time for slip in polycrystalline materials or how it varies as a function of temperature. For these cases where the strain gradient is large and the strain rate high, the plastic deformation that occurs will not allow a redistribution of the stress; if, however, the strain rate is low, the strains will redistribute themselves. This redistribution is obviously de-

pendent upon the relaxation time and relaxation energy of the atoms. If we knew coefficients of diffusion of the atoms, as a function of the strain, we might have a better insight into this phenomenon.

Let us now turn our attention to a problem of current importance to the Office of Naval Research, that of the development of heat-resistant materials for gas turbines, rockets and atomic energy power plants. During the war most of the work carried on in this field was done by empirical methods based upon knowledge gained prior to the start of the war. It was known that alloys containing high percentages of nickel and chromium and the nickel-chromium-cobalt alloys showed promise for use at elevated temperatures. During the war literally hundreds of alloys were made by varying the nickel-chromium-cobalt ratios and adding various alloying elements, such as titanium, columbium and vanadium, which formed stable carbides. This period could be considered as a test period, wherein many of the alloys were evaluated from their creep, stress rupture and fatigue properties. This sort of "research" program seemed necessary because of the great urgency and mainly because there was not enough fundamental information available upon which an alloy could be designed.

The program of the Office of Naval Research in this field is devoted to studies which will try to uncover the underlying factors governing the behavior of metals at high temperature. Of course, if we know all of the factors outlined in the section on the behavior of metals under applied stress and all of the factors concerned in the reactions of metals, our problem would be solved. But we don't. We must then start all the way back, and first obtain the equilibrium diagrams for the metals we are now using. This is basic to our thinking. From this, we can at least find out what is happening to the microstructure of our metal at the various temperatures and perhaps be in a position to devise a heat treatment to develop the optimum mechanical properties. This is only the start, for, since these metals are generally of a precipitation hardening type, we must know something about the precipitation mechanism and how it behaves under various stress and temperature conditions. It may be that, for a given metal, the rate at which the precipitation occurs and the rate of coalescence of the precipitate govern the stress-rupture and creep strength. It is obvious that if the precipitation occurs and coalesces rapidly, all of its beneficial effects will be lost. The effect of the carbide-forming elements, then, seem to slow up the rate of diffusion of the carbide particles, and it remains to find whether the alloying elements in solid solution and the type of carbide have any influence. In many cases, when the applied stress and the strain rate are low, deformation occurs near the grain boundaries, rather than in the interior of the grain. This type of deformation is associated with the energy distribution of the atoms in this region and is markedly influenced by the grain size and alloying elements in solid solution. This grain boundary deformation seems to be very definitely connected with the internal friction or relaxation energy of the atoms. Besides the above factors to be studied, there is the recrystallization to be determined.

In order to supplement and augment these studies, work has been initiated for the "Effects of Stress Concentration and Triaxiality on the Plastic Flow of Metals." Experimental data will be obtained and analyzed to explore the factors which determine the ductility and energy-absorption of metal specimens of various shapes. It is intended to find the solution initially for the distribution of stresses and plastic strains in simple geometrical forms and later to more intricate cases. The study will include a determination of the effects of state of stress—that is, biaxial or triaxial, strain gradients, stress concentration, temperature, strain rate and size effect.

Those of you who have examined details of the fractured surfaces of specimens have seen as many as six distinct structures, whereas only one is usually observed by ordinary metallographic techniques. The use of the fractrography technique promises to give additional information about plastic deformation, precipitation phenomena and the subcrystalline structure of metals. Specifically, work is being sponsored to give a general orienting review of various metals and alloys to classify the revealing variations which have significance with regard to the lattice structure and the location of the element in the periodic table. A study will be conducted on the changes in structure of several constitutional systems, such as the iron-silicon, bismuth-zinc and bismuth-antimony, to correlate the appearance of the facets with the physical properties and conventional metallographic interpretations. The effect of heat treatment and the presence of minor impurities, such as phosphorus, nitrogen and hydrogen, on the crystal facets will be studied.

Intimately connected with the plastic deformation is the mechanism of slip and twinning and the diffusion of like atoms under an imposed stress. Accordingly, a program starting with simple materials such as copper and zinc for determining the rate of diffusion of copper atoms through copper and zinc atoms through zinc when these metals are placed under simple tension and compression has been initiated. Measurements of the relationship between diffusion rate and strain within and beyond the elastic limit will be made at various temperatures. Initial measurements on single metal crystals will be made to provide information for the interpretation of polycrystalline materials. It is expected that this research work will give information on the role of diffusion on the recrystallization of binary alloys under the action of stress and temperature variations and also yield information on the internal changes in metals occurring under conditions of vibration. It will be recognized that the alloys used for heat-resistant materials for gas turbine rotor blades are in part subjected to conditions where recrystallization and vibration effects may occur.

In this study of the diffusion in stressed metals, radioactive tracer techniques will be employed to follow the migration of atoms during the diffusion processes.

Studies are currently underway for work in "Minetics of Reactions in Solid Metals." This field, which is the basic science of the heat treatment of alloys, such as the age-hardening of duralumin and the hardening of steels, is also directly connected with the mechanical and physical properties of metals. It is also directly related to the plastic behavior of metals and to the recovery and recrystallization following cold work. To secure knowledge in this field, the coefficients of surface, volume and grain-boundary diffusion of the various elements in steel, copper and aluminum alloys will be determined. For the reactions that occur in the heat treatment of steel, these diffusion data will be used to explain the mechanism of austenite decomposition, in an attempt to explain this phenomenon on such fundamental parameters as the size of the diffusing elements and the atomic number. Radioactive elements will also be used in this work, and through this technique data will be obtained on the vapor pressures of several metals and their alloys. From such data, the thermodynamic activity coefficients can be calculated and the pressure-temperature-concentration diagrams of the alloying systems determined. The radioactive tracer technique will also be employed to determine the concentration of the solute at grain boundaries and the constitution of grain boundary material in embrittled metals. Attempts will be made to measure the carbon concentration in austenite at the pearlite-austen-

ite interface during the growth of pearlite. The segregation of alloying elements during the decomposition of austenite may also be followed by the use of radioactive materials.

The effect of alloying elements on physical and mechanical properties has long been clothed in mystery, because of the lack of systematic attack on the problem. A fairly good start has already been made in determining the effect of alloying elements on hardenability, tensile strength, yield point and resistance to tempering. However, very little is known as to how they affect the transition temperature form fibrous to brittle fracture during impact. In a project, only recently gotten underway, an attempt will be made to separate the influence of alloying elements from the effect of microstructure. Specifically, we would like to know whether all steels have the same transition temperature at the same hardness when heat treated, so as to insure a completely martensitic structure after quenching, or whether the alloying elements, *per se*, exert an influence.

In another investigation, it is desired to study the effects of alloying elements on the plastic properties of aluminum alloys. Effective stress-effective strain curves of specially prepared high-purity aluminum alloys will be determined with the objective of formulating theories governing the laws of plastic flow and fracture. The laws for fracture and the plastic properties will be studied in terms of the atomic numbers, atomic radii and concentration of the foreign elements. The high-purity alloys will be prepared with uniform grain size and freedom from inclusions and segregations.

One of the problems that have defied all attempts of solution is that of temper brittleness. Many steels when tempered at intermediate temperatures or cooled too slowly from high-tempering temperatures suffer a loss in impact strength. It is known that several of the common alloying elements tend to increase the susceptibility to temper brittleness while others tend to decrease the susceptibility. However, the mechanism of temper brittleness is not at all fully understood. The mechanism is generally supposed to be similar to that involved in precipitation hardening in which carbon, oxygen and nitrogen exert such a powerful influence. The effect of these elements on the susceptibility to temperature brittleness, however, has as yet never been fully understood. By careful control of the purity, chemical composition and melting practice, the effect of alloying elements and impurities in causing temper brittleness will be investigated under one of our contracts.

In still another project concerned with the effect of alloying elements the grain growth in metals will be studied. This study will be a fundamental investigation of the grain growth in metals and alloys, with particular emphasis on aluminum and magnesium. The grain size will be studied as a function of annealing temperature, time and chemical composition. It is planned to investigate the isothermal grain growth in aluminum of 99.99% purity to determine the mechanism by which elements such as manganese, molybdenum and titanium inhibit grain growth.

The behavior of a metal in service seems to depend not only on its chemical composition and heat treatment but also on how it was made. Thus, work has been initiated to study the "Kinetics of Reactions in Steel-Making." In this work emphasis will be placed on the determination of the rates of reaction and the chemical species of the reactants in the slag-metal reactions. The sulphur and oxygen distribution coefficients between the slag and metal and the rate of diffusion of these elements across the slag-metal interface are to be measured. Electrical conductivity and electromotive force studies will also be made to gain some insight into the degree of ionization of the slag components and the molecular constitution of slag. Radioactive tracers will again be used in this study as an aid in measuring the rates of reactions, the chemical activity and the molecular species.

Of particular importance at this time are studies leading to the development of alloys for high temperature applications. The research programs being conducted under the sponsorship of the Office of Naval Research differ from those that were conducted during the past war in that we are endeavoring to find the reasons why the alloys behave as they do. It is believed that if we can uncover the fundamental principles governing creep, recrystallization, precipitation and coalescence of secondary phases, and fatigue as outlined in some of our other research programs, we can apply this knowledge to the design of new alloys for use at high temperatures. To obtain specific information on the behavior of heat-resistance alloys, studies are presently underway to determine the phase diagrams of the cobalt-chromium and cobalt-chromium-carbon systems. Later this will be extended to the more complex phase diagrams such as the nickel-chromium-cobalt and nickel-chromium-cobalt-carbon systems. The heat resistant alloys will be thoroughly explored so that the influence of grain size, crystalline structure and heat treatment on the stress-rupture, fatigue and creep properties can be determined. Statistical studies to correlate laboratory data with actual service or simulated services tests such as the "hot spin test" are in preparation. The Office of Naval Research has also considered including in this program an investigation of the factors that affect the weldability of the heat-resistant alloys. This is a very important phase of the work and is one that will need lots of attention. At the present time, the gas turbine buckets are being attached to the rotor wheels by mechanical means. This method works very well but involves a great deal of breaching and machining operations. This is not necessarily a serious situation when time and machines are not at a premium, but in case of another national emergency there would not be enough machines in this country to carry out the necessary operations to produce the number of gas turbine power plants that would be needed. The answer to this problem lies in our ability to develop our welding skills.

Since the alloys used in gas turbines are subject to attack by the hot combustion gases, corrosion studies have been sponsored. These investigations will seek basic information on the atmosphere reactions with metals and the effect of such reactions on the deterioration of metals when stressed at elevated temperatures. The stress-corrosion tests will be conducted in inert atmospheres and in the various environmental atmospheres to which the alloys are commonly subjected.

While the research programs just outlined pertain to those alloys to be used at temperatures not in excess of about 1600 to 1700° F., we are looking forward to materials that can be used up to 5000°. Thus we have turned our attention toward intermetallic compounds that have high melting points and good corrosion resistance at the elevated temperatures. The Navy's investigation is concerned with research and development in the field of cemented chromium borides. Chromium borides have high melting points and retain their hardness at extremely high temperatures. In this investigation, the equilibrium diagram for the nickel-chromium-boron and cobalt-chromium-boron systems will be established. However, only those portions of the diagram that will be useful in the development of heat-resistant materials will be carefully determined. After the solubility of chromium boride in nickel and cobalt is found, the mechanical properties will be investigated at the elevated temperatures. It is intended to vary the composi-

tion of the chromium borides for its effect on the ductility and strength of the cemented compacts. In the course of this work studies will be made of particle size, hot pressing techniques and the effect of compacting temperature and pressure.

One of the most important of our metallurgical problems, and one which you as a metallurgist should keep in mind, is to ascertain the full possibilities of all of our strategic materials to prevent undue shortages in any future national emergency. You are all too familiar with the difficulties encountered during the war and how well we did in alleviating our troubles in spite of the pressure. I am sure that now that we have time to think about this problem, we can uncover new alloys or improve those which we are now using so that substantial saving of our strategic materials can be accomplished.

Now the question that must be foremost in your minds is—How does the metallurgical program as given above fit into the Navy's general problem and how does the general program require the attention of all of the scientific fields? A few examples might serve to answer these questions.

The Navy is the greatest consumer of power in the world. The prospects of harnessing atomic energy for the purpose of driving ships in the near future is an attractive possibility and we are engaged in research which we hope will lead us to a solution of the problem.

In a large vessel, the elimination of the boilers and associated auxiliaries, to say nothing of the thousands of tons of fuel oil, will make possible a more advantageous disposition of weight. The application of this principle to commercial carriers is obvious. The bottoms of ships can be materially strengthened by using thicker plate, the whole hull structure can be materially strengthened, and armor can be more generally used, all with the idea of making ships less vulnerable to attack by atomic or other forms of bombing. However, the atomic power plant engineer cannot even start without at first consulting the physicist to obtain information on the nuclear reactions, the chemist for his thermodynamic data, the metallurgist for his material that will be able to withstand the ravages of the neutron bombardment. Further, the metallurgist himself cannot properly start to design his alloys without knowing the type of nuclear reactions that will occur when his metal is exposed to the atomic pile. This same situation also holds for the chemist and the engineer who must know what type of liquid or gas to use for the heat transfer medium.

Through the use of atomic energy, fuel economy will no longer be the essential factor so that turbines can be completely redesigned with the sole idea of increasing the amount of horsepower per pound of turbine as much as possible. With this increase in horsepower, greater speeds will result which will necessitate a radical change in the design of the underwater portions of the vessel if full advantage of the power plant is to be attained.

Here again each advancement is dependent upon the other. If one scientist fails, the other cannot achieve his goal.

Another thing you have heard and read about is guided missiles. They may be torpedoes, drone airplanes or any airborne carrier of explosives. Considerable research in many directions is necessary before much progress can be made in this development. They must attain tremendous speeds—necessitating extensive delving into metallurgy for ways and means to make metals which will withstand the extraordinarily high temperatures. It means additional fundamental work in electronics, radar, even television. Above all, the special power plant is needed to drive the missile at the great speed it must have. Obviously better metals are needed here. In this particular case, the entire development depends upon our ability to find materials which will be able to give satisfactory performance at these elevated temperatures. All of our work in radar, electronics and television would be useless for these applications unless this latter problem is solved.

Driving missiles or aircraft at extremely high velocities will no doubt impose many problems which have not been encountered heretofore. Let me pose some that occurred to me. (1) Can we improve our armor plate to withstand the shock of atomic bomb explosions or can we even improve our armor plate so that it will prevent a rocket-propelled missile from penetrating? (2) What is going to happen to our metals when air at supersonic speeds is passing over them? Is the corrosion rate of our metals going to increase because of the removal of the protective films by the rapidly moving gases? (3) What about our fatigue problems, especially when the craft is passing from the subsonic to the supersonic regions where great variations in the fluid properties of the atmosphere are encountered? Are we going to shake our aircraft apart?

These are some of the problems we will endeavor to answer in the very near future. The answer to them can be found only by intensive and coordinated research work and by augmenting the research facilities of our country.

You all know by now of my retirement from the Navy. I have spent over 45 years of my life in the Navy. Most of the service has been in engineering and allied fields. My experience has taught me never to relax, sit back and say we have the last word in power plants, armament, radio or anything else needed in the Navy. I know as well as any one that we must extract every bit of knowledge we can which will help us build and maintain the best ships, the best planes, the best equipment in the world.

Retirement to private life will not in any way lessen my interest in science and scientific enterprise. I shall watch with a professional and practiced eye the developments of the future. Happily, I am neither pro- nor antibattleship—I am interested only in a strong, modern and invincible Navy which by its very existence will be security insurance for our people.

Welded Brake Straps for Excavators

By William C. Black*

TODAY there are prevalent reports of inferior materials and shortages. The supply of coal is one of the major problems in the world today, and to increase the output of this commodity, excavators are being used extensively in open cast coal mining. Owing to the gravity of the situation three shifts are worked per day. This produces arduous service conditions and due to shortage of man power it is sometimes difficult to maintain these excavators in first class working order.

For a number of years excavator manufacturers have incorporated in their designs mild steel brake straps with welded end connections. These straps vary in size from 1 ft. 8 in. to 6 ft. 0 in. in diameter and have given complete satisfaction under the service conditions mentioned above when the design has conformed to the correct welding procedure.

Engineers and welding personnel realize that to obtain first class results, welding must be approached with the same technical and practical thought as is given to other branches of engineering. Today, one may still see many welded designs using a fabricated construction designed primarily for rivets. This often produces an uneconomical design both in weight and production costs.

Brake straps can be usefully cited as one of these instances where a reduction in the production costs can be obtained by making full use of the proper welding technique.

The change from rivets to welding was desirable because of the very considerable reduction in strap section due to the number of rivets required in cross section when using straps of minimum thickness for flexibility. The reduction in area is at the section where maximum load occurs and fractures due to fatigue are often found at the first rivets of straps operating under continuous service conditions. Figs. 1-3 show the generally accepted practice for riveted strap connections.

Before proceeding further with the design of welded end connections, let us consider the design requirements for an efficient brake strap.

(*a*) Strap must be flexible and accurately lap the drum at all points.

(*b*) Pin friction at the tight end has a tendency to retard the strap movement on the larger sizes of brakes. Therefore, it is essential to have flexibility and to avoid rapid changes of stress at the point where maximum load is present.

(*c*) Wherever possible, attachment should give a central pull to avoid secondary bending stresses.

(*d*) Welds must be balanced to minimize plate distortions

(*e*) Length of weld and number of parts

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Fig. 1

Fig. 2

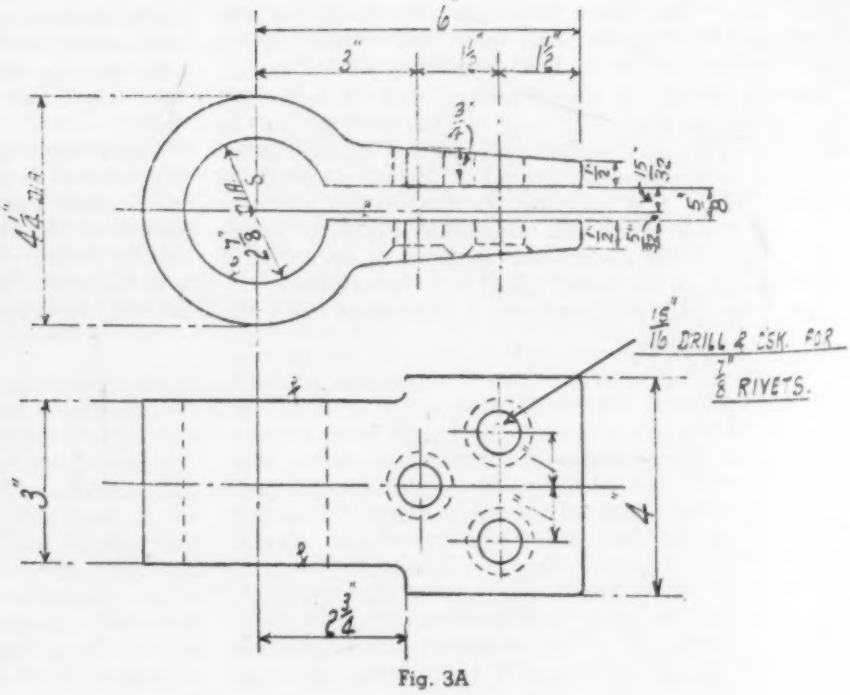


Fig. 3A

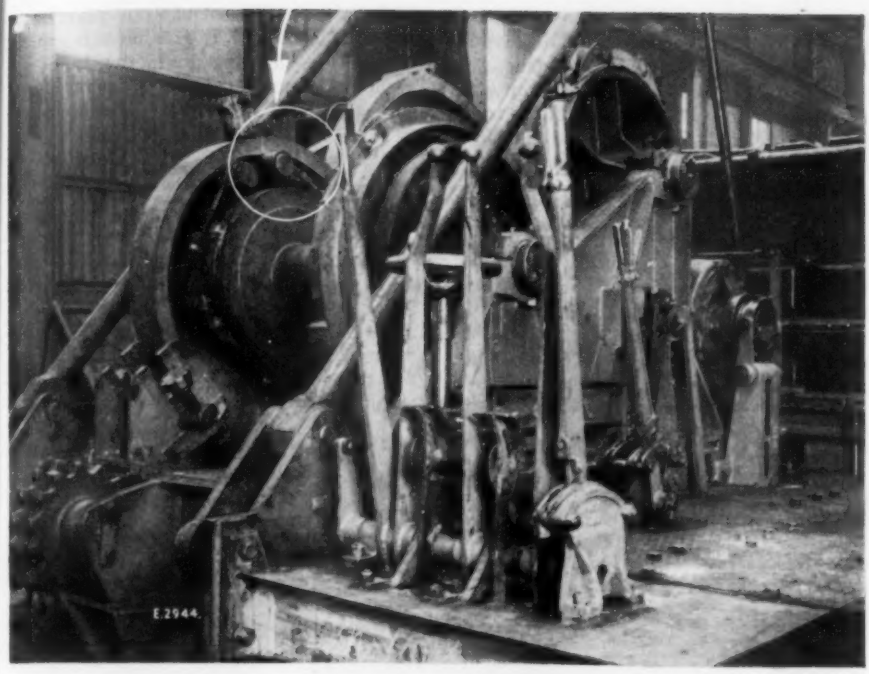


Fig. 3B

Fillet Welded Connections

The method adopted by many engineers is illustrated by Fig. 4 which is identical with Fig. 3 excepting that the rivets are replaced by welding.

The built-in effect or rigidity produced by welding has a tendency to accentuate the stiffness at the joint, whereas in the case of rivets the built-in effect is less severe. The change in stress line is shown diagrammatically at XX by Figs. 5 and 6, assuming the ends are square as shown in Fig. 3.

This type of connection becomes very large in comparison with its strap for heavily loaded brakes. Therefore it is very difficult to avoid the rapid change of stress shown in Fig. 6 and additional plates are often welded to the strap to obtain a more nearly uniform flow of stress.

The milling of the slot which is a relic of the rivet connection, Fig. 3, presents a machining problem for plate thicknesses up to $^{5}/_{16}$ in. Many cutter breakages occur due to the slots being long and narrow, and to overcome this the slots are sometimes milled out larger than necessary and closed to the required thickness. This is not a very satisfactory procedure and shows high production costs.

A design of end connection to overcome the milling problem and making full use of burning, which is an operation closely associated with welding, is illustrated by Figs. 7 and 8.

The strap is burnt out to the contour of the connection and the parts are attached each side by fillet welds, thus avoiding plate distortion. Having dispensed with the slot, the connection can be reduced in size, which gives a much smoother flow of stress than obtained with Fig. 6.

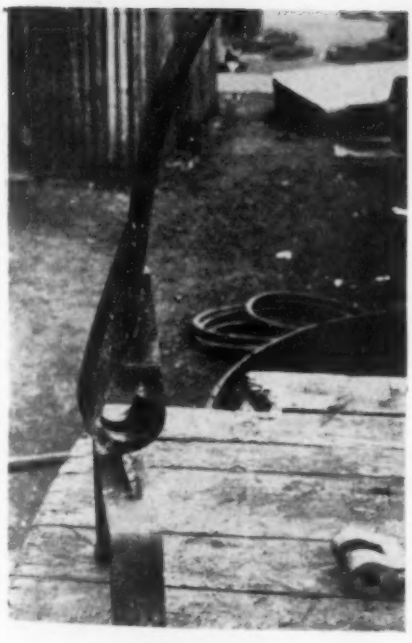


Fig. 4

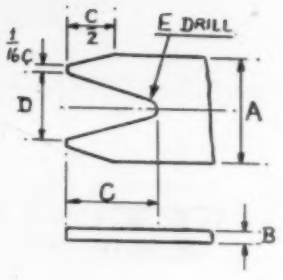


FIG 7

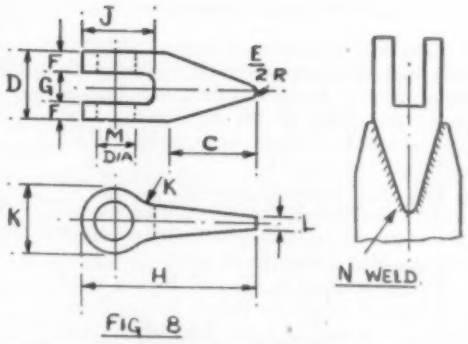
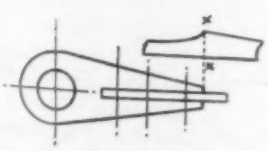


FIG 8

LOAD IN STRAP	A	B	C	D	E	F	G	H	J	K	L	M	N
3 TONS	3"	1/4"	3"	2 1/4"	1/4"	21/32"	15/16"	6"	2 3/8"	2 1/4"	5/8"	1 1/4"	3/16"
4 TONS	4"	1/4"	4"	2 3/8"	1/4"	25/32"	1 1/16"	7 3/8"	2 3/4"	2 5/8"	5/8"	1 1/2"	3/16"
6 TONS	4"	3/8"	4"	3"	1/4"	29/32"	1 3/16"	7 3/4"	3 1/8"	3"	5/8"	1 3/4"	1/4"
7 1/2 TONS	5"	3/8"	5"	3 1/4"	3/8"	1 1/32"	1 3/16"	9 1/4"	3 1/2"	3 1/2"	7/8"	2"	1/4"
9 TONS	6"	3/8"	6"	3 3/4"	3/8"	1 1/32"	1 5/16"	11"	4"	4"	7/8"	2 1/4"	1/4"
12 TONS	8"	3/8"	8"	4 1/4"	3/8"	1 13/32"	1 1/16"	13 3/8"	4 3/8"	4 1/2"	7/8"	2 1/2"	1/4"
16 TONS	8"	1/2"	8"	4 1/2"	1/2"	1 15/32"	1 3/16"	13 3/4"	14 3/4"	5"	1 1/8"	2 3/4"	5/16"
18 TONS	9"	1/2"	9"	4 3/4"	1/2"	1 17/32"	1 1/16"	15"	5"	5 1/4"	1 1/8"	3"	5/16"
22 TONS	9"	5/8"	9"	5 1/4"	1/2"	1 23/32"	1 13/16"	15 3/4"	5 1/2"	5 3/4"	1 3/8"	3 1/4"	3/8"

Table A

Fig. 5



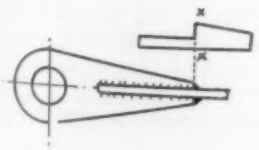


Fig. 6

should be reduced to a minimum to keep the over-all production costs down.

From the foregoing it will be seen that flexibility and uniform stress are the most desirable features in brake design.

The design of welded end connections can be placed under two headings, namely (*a*) fillet welded connections, (*b*) butt welded connections, and these will be considered separately as each type require a different line of approach and welding procedure.

Table "A," gives the proportions of straps for pulls of 3 to 22 tons and are based on experiments carried out by the writer. The joint has been designed for the strap to fail before the weld. The loads are calculated on a working stress of 4 tons per sq. in. in the strap in conformity with general practice.

Specimens were tested with large and small drilled holes at the end of the burnt slot in the strap. The experiments showed that for the best results it is desirable to keep the drilled hole as small as possible. Figure 9 illustrates one of the specimens tested, the strap having yielded and the pin hole elongated under a load of 24 tons. The strap section was 3 in. wide by $^1/_4$ in. thick and $^3/_{16}$ in. weld fillets were used.

For straps $^3/_8$ in. thick and upwards, the design of connection Fig. 8 can be further improved as shown by Fig. 10, which gives a lighter section and a smoother flow of stress. If the end connection is made a drop forging the double chamfer for welding can be produced by the dies. The production costs are slightly higher than for Fig. 8 as the welding takes a little longer and there is also the initial cost of the dies to be taken into account. If the end connections are to be manufactured in fairly large quantities, the initial cost of the dies is well worth consideration as it is a better design for welding procedure.

Butt Welded Connections

Tests and experiments have established that butt welds are preferable to fillet both from uniform stress and fatigue points of view, especially if the reinforcing and sealing welds are removed at points "AA" and "BB" in Fig. 11.

The butt joint illustrated by Fig. 12 enables the connection to be designed to give a smooth stress line without any rapid changes in cross-sectional area.

The same load is allowed in the weld and parent metal for joints having reinforcing and sealing welds, and when these are omitted the weld load must be reduced to 60% due to the notch effect at root and edge of plate.

To ensure that the weld metal is sound throughout the joint it is essential that the runs start well outside the plate. This can be accomplished by tack welding to the plate edge, $1^1/_2$- x $1^1/_2$- x $^1/_8$-in. angles, which have been set to suit angle of joint preparation (see Fig. 13). Peening or post-heating should be carried out when the joint requires four or more runs of weld. After angles have been sawn off, reinforcement and sealing welds and edges of plate are buffed flush to minimize stress concentrations and thus obtaining an efficient joint.

For balanced welding the plate should have double vee preparation. The writer considers the single vee is entirely satisfactory for straps up to $^3/_8$ in. in thickness, providing the strap and connection are securely clamped on the jig and peening or post-heating is adopted. The single vee avoids turning the work over, and this saves valuable man hours which are an important item when manufacturing straps in large quantities.

It will be realized that the procedure just mentioned for the butt joint is more costly from a production point of view than the fillet welded joints illustrated by Figs. 8 and 10. In spite of the disadvantages in cost, the butt joint for straps $^3/_8$ in thick and upwards has great advantages as it keeps the size of connection to a minimum giving flexibility and uniform stress which are two essential features in correct brake design.

Welding Jigs

Brake straps are generally made in halves to facilitate the replacing of worn linings. For single items or small production orders an expensive jig should be avoided and a simple Tee piece, illustrated by Fig. 14, is all that is needed.

The strap is first set out on the marking out table and the end connection tack welded after which the tee piece is welded in position. During production it is very difficult to maintain the true curvature and alignment of strap and the tee piece is retained in position until final assembly on excavator.

The ideal method is shown by Fig. 15 where the strap can be clamped to the true curvature in machined groove before welding. This jig can be designed to suit butt and fillet welding and being pivoted, the work can be brought into the best position to suit operators. It is desirable to weld a tee piece, as suggested for Fig. 14, to maintain true curvature and alignment of strap.

Fig. 9

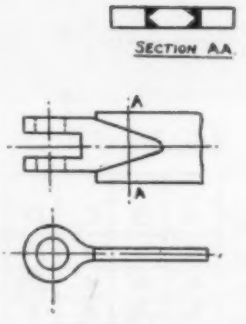


Fig. 10

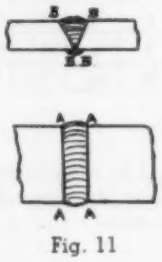


Fig. 11

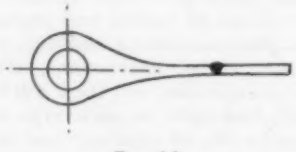


Fig. 12

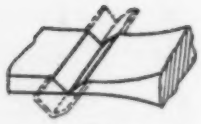


Fig. 13

Fig. 14

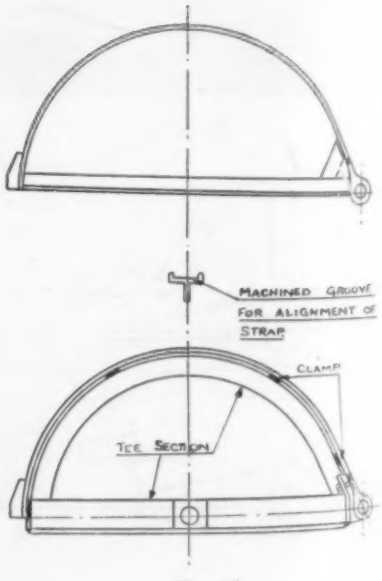


Fig. 15

Radiography as a Control for Welding Joints in Pipe Lines*

By Russell G. Rhoades†

AT TIMES we may ask ourselves—why do we work for industrial progress? Why do we work for ever-increasing production efficiency? The answer to this query may lie in the fact that constant recurrence of change acts as a stimulus and a challenge. However, it is our fulfillment of this industrial efficiency in our work each day which distinguishes us as American individuals in our daily standard of living over any other group of people on this earth.

It is human tradition to keep close to the beaten path and live today by the habits of yesterday. Someone has said, "At times we must take a pole to drive a cow to new pastures." However, we are always proud of ourselves when we find that we, by some good common sense and reason, have turned from our old ways and have given ourselves to the new. New uses for old techniques are constantly being discovered by engineers and technicians in every line of endeavor. This paper deals with the new use of a previously known technique with some adaptations.

Radiography is not new in its use to inspect and control welding, but it is new to use radiography on a pipe line where groups of construction men work with the force and speed necessary to weld, treat and complete the laying of 4000 to 10,000 ft. of line per day.

Theories and processes developed in the laboratory have sometimes proved impractical when put to actual field use. However, in this case we actually used the methods, to be described later, on the construction of 176 miles of 18-in. high-pressure oil line for a major oil company—The Standard Oil Company of California.

The vistas opened by the development of this new technique are limitless; however, this report shall be confined to its use in pipe line work only.

First, both the customer and the builder receive benefits when each takes the available advantages which radiography offers in constructing an all-welded pipe line. This means there must be close coordination between the customer and the builder in their efforts to build a pipe line with predetermined joint specifications.

The inspection department of the customer and the welding supervision of the builder will work in common understanding when together they have adequately tested enough joints to establish welding standards. When the test results of any welding procedure reveal sufficient and substantial evidence—only then a standard of welding quality in detail can be determined.

Since using radiography in constructing a pipe line is relatively new and considering the kind of men who lay pipe lines, we see the importance of providing a common working knowledge of radiography—what a radiograph reveals coordinated with results of physical weld tests.

The prime objective which we must accomplish in welding any pipe line is to weld a joint of 100% efficiency in all the physicals to which a pipe line may be subjected in the course of its life. A 100% joint in a pipe line is composed of approximately 90% tensile with the 10% remainder found in ductility. A pipe line joint seldom requires attention to such physicals as torque, shear and fatigue to any appreciable degree. We still would have some difficulty welding all the physicals in the weld deposit perfectly and identical to the parent pipe. If we should weld all the physicals equal to the parent pipe, in size, thickness and shape, virtually we would have produced seamless pipe.

We must control the elements which give us a homogeneous welded joint with the least weld deposit. After we have established the necessary physicals of our procedure, the shortcomings we must minimize in acquiring both construction efficiency and joint efficiency are as follows:

1. Misalignment of pipe ends.
2. Lack of penetration.
3. Burned through areas.
4. Slag inclusions (gas pockets).
5. Undercuts (outside, inside).
6. Size and shape of weld (outside and inside—especially inside).

To minimize these deficiencies in welding a pipe line we continue to use several established ways of inspection. Most of these ways are clumsy and costly. They are usually operated with awkwardness and they are greatly lacking in thoroughness and accuracy.

Radiography is steadily being found as a new and more simple means to quickly recognize and evaluate the above-described shortcomings. We can see build-up and undercut on the outside with the naked eye, but the joint cannot be reliably evaluated until it is considered with the condition on the inside of the pipe. Radiography has no equal in providing the facts of these welding conditions in a pipe line.

To provide sufficiently powerful mobile X-ray equipment behind the fast working pipe line welders and yet preceding the treating and line-laying crews, would involve prohibitive transportation costs.

Radium in capsule form is an excellent light source because it is self contained in a capsule. These capsules are small, being approximately 3/4 in. in diameter and 1 in. long, and often shaped like a pear or a schoolboy's top.

In using either X-ray or Gamma ray, when both the light source and film are on opposite sides of the pipe, other disadvantages are always present, such as producing an elipse radiograph. The light must penetrate the obstructing opposite side wall of the pipe before it can reach the small portion of the weld on the other side. This is especially a disadvantage with big-inch pipe, and double wall thickness, of course, requires double exposure time. The distances from the light source to the various

* Presented at January 27th Meeting, San Francisco Section, A.W.S.
† Welding Engineer, Bechtel Corporation of San Francisco, Calif.

points on the film are unequal which hinders uniform film exposure. By the angle of the lines by which the light travels from the source through the weld and reaches the film in its circular position outside the weld, the image on the film is produced in non-uniform distortion.

Our objective and our accomplishment has been to place this light source on the inside of the pipe, and the film around the outer periphery of the pipe wall This is achieved by cutting a small hole in the pipe near the joint to be tested, and inserting the radium capsule inside by means of a specially constructed self aligning jig. This could not be done with cumbersome X-ray equipment. Placing the radium or light source on the inside of the pipe provides the following advantages:

1. The complete circumferential weld can be examined with a single exposure. All the film is equidistant from the light source.
2. Distance from light source to film is reduced, thus exposure time is reduced by the square of the distance.
3. The single wall thickness, compared with two through which the light must pass, also reduces the exposure time by half.
4. All the radiograph of the weld on the film is exposed to scale and without distortion or any elipse. This is a factor which provides accurate detail.
5. Considering the direction of the lines which shape the full bevel or V from the outside, further advantages are gained in radiographic detail when the film is placed on the outside and light source is on the inside, in contrast to vice versa.

With 300 milligrams of radium, using fine grain film and proper screens on 18-in. pipe with quarter inch walls, an exposure can be made in 12 to 14 min. The film may be developed and read in 15 to 30 min. after it has reached the darkroom.

The hole cut in the pipe is welded by using a special inverted spigot plug. Engineering actually shows that a $^3/_4$-in. hole in a large diameter pipe does not weaken the over-all strength of the pipe. In fact we did not experience a single leak by using this type of plug with the full fillet weld, and this procedure was highly satisfactory to both customer and the engineers.

These radiograph methods with the hole as we have described are in the specifications of a portion of the Texas Los Angeles 30-in. gas line.

On the job to which I have previously given reference were employed the Industrial X-Ray Engineers of San Francisco. By close coordination between the X-Ray Engineers, the customer and the contractor a set of standards and specifications were established.

We accomplished this end by welding 20 pipe joints each of which was known to include one of the following conditions: misalignment, lack of penetration, burn through areas, gas and slag pockets, undercuts, different weld sizes and shapes, and perfect welds. These joints were radiographed and indexed as to location and irregularity. Coupons from the above 20 joints were given physical tests after being cross indexed with the radiograph film. The results were then correlated with our findings on the film to be used as a basis for a set of standards. This whole procedure was meticulously carried out, and any uncertainties were retested and rechecked.

Because of the accurateness and regularity with which these radiographs provided in a daily record of the type of joint being welded in the pipe line and when compared to the established standards, the work had scarcely started before radiography had proved itself indispensable to both the customer and the contractor.

It is generally known that through inadequate or negligent handling, radium is not without its dangers. This is one reason trained engineers should be employed to use it on a pipe line.

Due to the extreme mobility required on a pipe line job, a house trailer as a combination laboratory, darkroom and office for compilation of records was used. A triplicate record was maintained of all welds radiographed.

A system of numbering the welds and locating the welds in the pipe line was radiographed on the film. Also a similar clock-wise numbering system registered on the film the exact location of any irregularity or defect in the circumferential weld.

When welders understand how radiography works they like it and they appreciate it in that it assists them to make a more perfect weld.

The number of radiographs required to control the welding on a pipe line depends upon the size of the line—the number of daily welders, etc. However 5 to 10% of the welds made are found to be adequate to provide dependable information.

The common disadvantages encountered in examining pipe line welds by the destructive methods are as follows:

1. The costs of replacing the section cut out for testing.
2. The machinery to prepare coupons and the equipment for testing is seldom readily accessible to a pipe line.
3. The natural forces tend to reduce testing to a point where a working knowledge of welding and joint value is practically out of the hands of the daily workmen and inspectors.
4. With the destructive tests, as we have commonly used in the past, we can only test the weld which we take out of the pipe line.
5. The tested weld never stays in the line.

With radium inspection, the welding force is daily informed of the standards by which they welded the joints in the line. And if there are any defects they know exactly what to do to correct the irregularities. The customer holds a permanent record of the tested welds in his pipe line. The builder knows the standard of joints he welded in the pipe line. The customer knows what kind of a pipe line was welded and what he receives.

The basis for success in using radiography on a pipe line or any similar welding job, is that both the builder and the customer must realize there is a benefit and a saving for each, then further reafize that a way must be provided whereby each will obtain his just portion.

Such critical information as provided by radiography must not be used by one to the disadvantage of the other, but must benefit all concerned. Gains will be more plentiful to all if radiography is accepted in the early planning of the welding project.

Briefly I have endeavored to cover the high lights of a new technique in welding analysis. I would summarize as follows: Mere mechanical processes and innovations are not enough to fully accomplish the full purpose. Radiography, however, provides more welding and joint information than ordinarily obtained from common methods of investigation. Efficiency is not attained as a result of uncertainties, or from common statements and beliefs. Instead, efficiency in pipe line welding, as in any other work, is found at its highest level only when all information and details available are applied to the fulfillment of that work.

The more we control the weld deposit in acquiring the needed physicals, the nearer the deposit will equal the pipe in thickness and shape. With radiography we raise two efficiencies—one in the joint, the other in our way to make it.

Spot Welders with Series Capacitors

By F. L. Brandt*

Introduction

SERIES capacitor applications to resistance welders are usually branded as expensive and limiting to the welding operations. This paper illustrates how inexpensive the capacitor installation may be and at the same time broaden the use of the welding machine. The application of the equipment is worked out including costs. Operation of the equipment is shown on oscillograms and related to the application data.

The kilowatt demand required to make any given resistance weld is nearly constant regardless how the welding conditions vary; however, the kilovolt-ampere demand will change as the welding conditions vary. As the area of the inductance loop of the welder increases to accommodate the conformation of the work, the kilovolt-ampere demand increases. The rate of this spreading between the kilowatt and kilovolt-ampere is represented by per cent power factor. If the power factor is 50%, the useful kilowatt is only 50% of the required kilovolt-ampere demand. Electric power is measured in kilowatt hours and the customer is billed for this kilowatt hour energy consumed. The physical size of the electrical cables and associated electrical equipment must be based on the kilovolt-ampere demand. If two customers are using the same kilowatt demand, but one has a much lower power factor, this low power factor creates a much higher kilovolt-ampere demand and thereby much heavier equipment in the power distribution system. This is one reason the power companies dislike low-power factor loads and insist on a demand charge independent of the kilowatt hour consumed. This is particularly true of resistance welding installations because the resistance welder is inherently a high-demand, low-power factor load. However, the weld itself is almost a pure resistance load; it is the means of getting the current to the weld that is highly inductive. If we supply sufficient capacitor reactance in the circuit to equal the inductive reactance of the welder, the kilovolt-ampere demand in the power line will equal the kilowatt demand and the power factor will be 100%. Since the kilovolt-ampere demand varies with changes in work on a given welder, the capacitor reactance required to correct the power factor to 100% would change with the work. Variable capacitors of this size are not practical, so the correction will have to be in jumps and the corrected power factor may vary from 90 to 100%. These capacitor units may be applied in series or shunt (parallel) with the load but of the standard control equipment available at the present time; the series application of the capacitors is less expensive and more readily available. Therefore, all uses of capacitors in this paper will be understood to be the series capacitor application.

In actual practice, the capacitors are designed to produce a slightly lagging power factor for the heaviest welding job the welder is expected to do. All lighter than the maximum welding job will require a lower kilovolt-ampere demand and the power factor correction will be less than that for the maximum designed job. Unless the work varies widely such as from aluminum to steel, there is little or no practical need for capacitor switching.

Let us make the necessary calculations for a practical installation. Assume we wish to spot weld two pieces of 0.093-in. clean cold rolled steel in an assembly that requires a 30-in. throat depth and approximately 8-in. throat spacing. Experience has shown that approximately 65 kilowatts is required to spot weld two pieces of 0.093-in. cold rolled steel. Experience has also shown that a standard spot welding machine to provide the above secondary circuit will operate at approximately 50% power factor. The demand will thereby be 65/0.50 = 130 kilovolt-amperes. Good welding practice recommends a 75 kilovolt-ampere (Resistance Welder Manufacturers Association) rated spot welder with 30-in. throat for this job. If the available power is at 230 volts, the corrected line current at 100% power factor will be 65,000/230 = 283 amp.

The voltage on the primary of the welder transformer (E_w) to be used will be equal to the line voltage 230 v. divided by the cosine of the power factor angle which we have given as 0.50 = 460 v. The welding transformer will be designed to give the customary secondary voltages of a 75 kilovolt-ampere 30-in. throat spot welder when the maximum primary voltage is 460 v. The voltage on the capacitors that we shall apply under these above conditions will equal the welder voltage multiplied by the sine of the power factor angle or 460 × 0.866 = 398 v. (E_c). The ohmic value of the required capacitors will equal the capacitor voltage, 398 v. divided by the line current 283 amp. = 1.35 ohm.

The nearest higher working voltage rating standard capacitor unit to the 398 v. is a 495 v. unit which has an ohmic value of 8.3 ohms. We would require 8.3/1.35 = 7 units connected in parallel at a cost of $90 per unit. A suitable enclosed rack will cost $70. If the spot welder were accidentally short circuited, the voltage impressed on the capacitors might exceed the maximum permissible voltage rating given by the manufacturer as 545 v. We must make the necessary calculations to determine this voltage under short circuit conditions. From experience, we know that the impedance of the standard 75 kilovolt-ampere spot welder under the given conditions is nearly 1.45 ohms on short circuit and the power factor is 32%. From these values we can calculate the impedance of the circuit. The resistance equals 1.45 ohms × 0.32 = 0.46 ohm. The inductive reactance of the welder equals 1.45 ohms × 0.95 (sine of the power factor angle) = 1.37 ohms. We have 7–8.3 ohms capacitors of a total of 8.3/7 = 1.19 ohms. The net reactance is inductive by 1.37 − 1.19 = 0.18 ohms. The net impedance is $\sqrt{0.46^2 + 0.18^2}$ = 0.49 ohm. The current produced in the series circuit by 230 v. is 230/0.49 = 470 amp. The voltage across the primary of the welding transformer equals 470 amp. multiplied by the welder imped-

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ance, 1.45 ohms, equals 470 × 1.45 = 682 v. The voltage across the capacitors equals 470 amp. multiplied by the capacitor reactance of 1.19 ohms equals 470 × 1.19 = 559 v. Over-voltage equipment may be supplied to protect the 545 maximum volt rated capacitors when the short circuit voltage of 559 v. is applied to the capacitors. This over-voltage equipment ($250) opens the firing circuit of electronic control and should be connected to trip the under voltage release of a suitable circuit breaker. The circuit breaker with instantaneous and shunt trip would be satisfactory for nonsynchronous magnetic contactor control.

As an alternate to the above capacitors and over-voltage equipment, higher voltage rating capacitors can be applied that will not require protection. There are 440 v. continuous voltage rated capacitors available that will withstand a maximum permissible voltage of 660 v. and have 10.5 ohms reactance.

Let us re-calculate using 10.5/1.35 = 8 units. The actual capacitor reactance of these 8 units equals 10.5/8 = 1.31 ohms. The net circuit reactance will equal the welder reactance, 1.37 ohms, minus the capacitor reactance, 1.31 ohms, equals 0.06 ohm (inductive-lagging power factor). The net impedance of the circuit equals $\sqrt{0.46^2 + 0.06^2} = 0.46$ ohm.

The current produced in the series circuit equals the line voltage 230 v. divided by the circuit impedance, 0.46 ohm equals 500 amp. The voltage impressed across the capacitors equals the line current, 500 amp., multiplied by the capacitor reactance, 1.31 ohms, equals 655 v. which is only slightly less than 660 v. maximum permissible rating of the capacitors. However, the line voltage will usually drop on short circuit and the resulting capacitor voltage will be less than calculated providing the transformer has sufficient iron to prevent saturation. As a matter of fact, the capacitors of the first calculation might be safe due to line voltage drop.

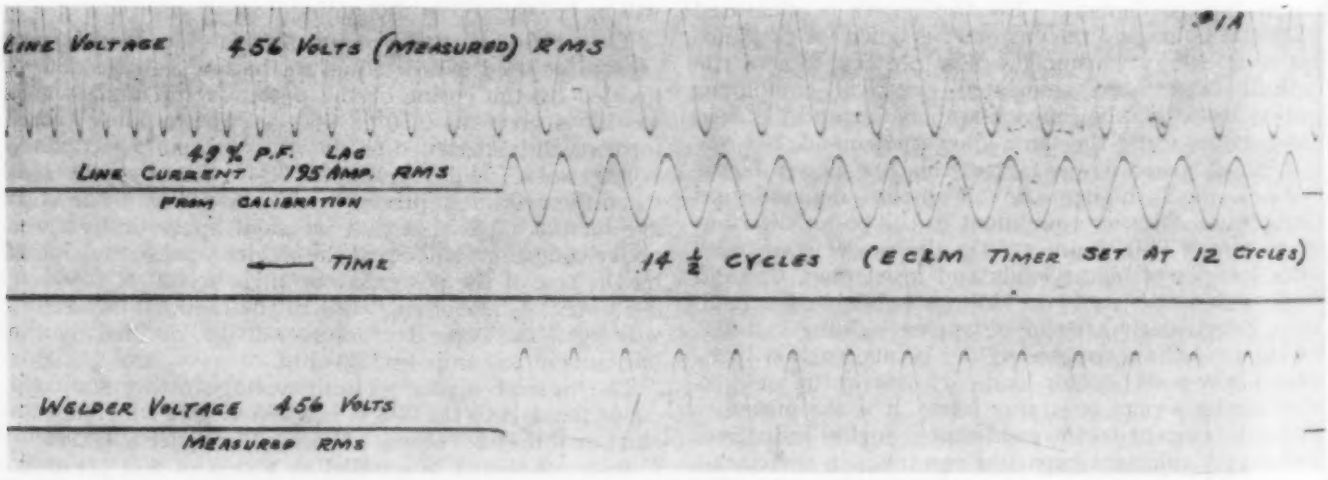
A size 2W welder magnetic contactor will be satisfactory means of making and breaking the circuit. The timing control could either be the motor driven cam of a press welder or a standard automatic weld timer.

Oscillograms are shown that picture an actual installation of our calculations. Since the welding transformer primary voltage in our calculations for 100% power factor is so near to a standard 440 v. rated transformer that the transformer used was actually of standard 440-v. 60-cycle rating. The extra taps supplied in the primary of the transformer provided a means of changing the welder impedance and thereby producing leading and lagging power factor in the line while welding the same work pieces of 0.093-in. cold rolled steel on succeeding welds. The cost of this series capacitor installation with magnetic control over and above the cost of a standard 75 kilovolt-ampere welder is as follows:

8	10.5-ohm, 440-v. capacitors @ $85.00...	$680.00
1	8-unit rack and enclosure.....	70.00
1	Standard automatic timer (Nema 3B)...	165.00*
1	2W Magnetic contactor, single pole.....	76.00*

Oscillograph 8C of the short circuit condition reveals that

Fig. 1



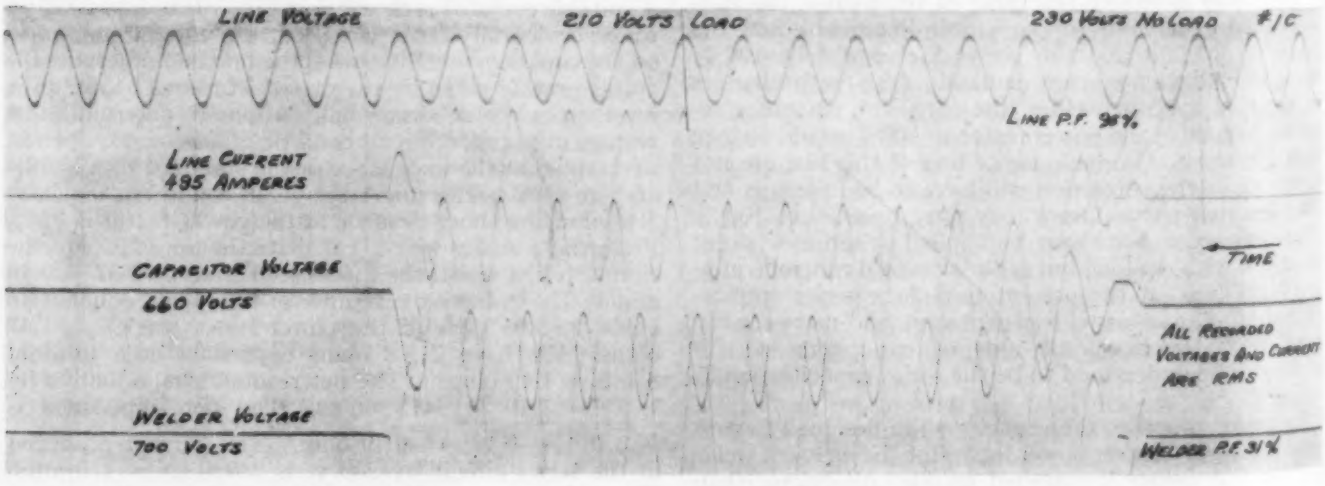


Fig. 2

Fig. 3

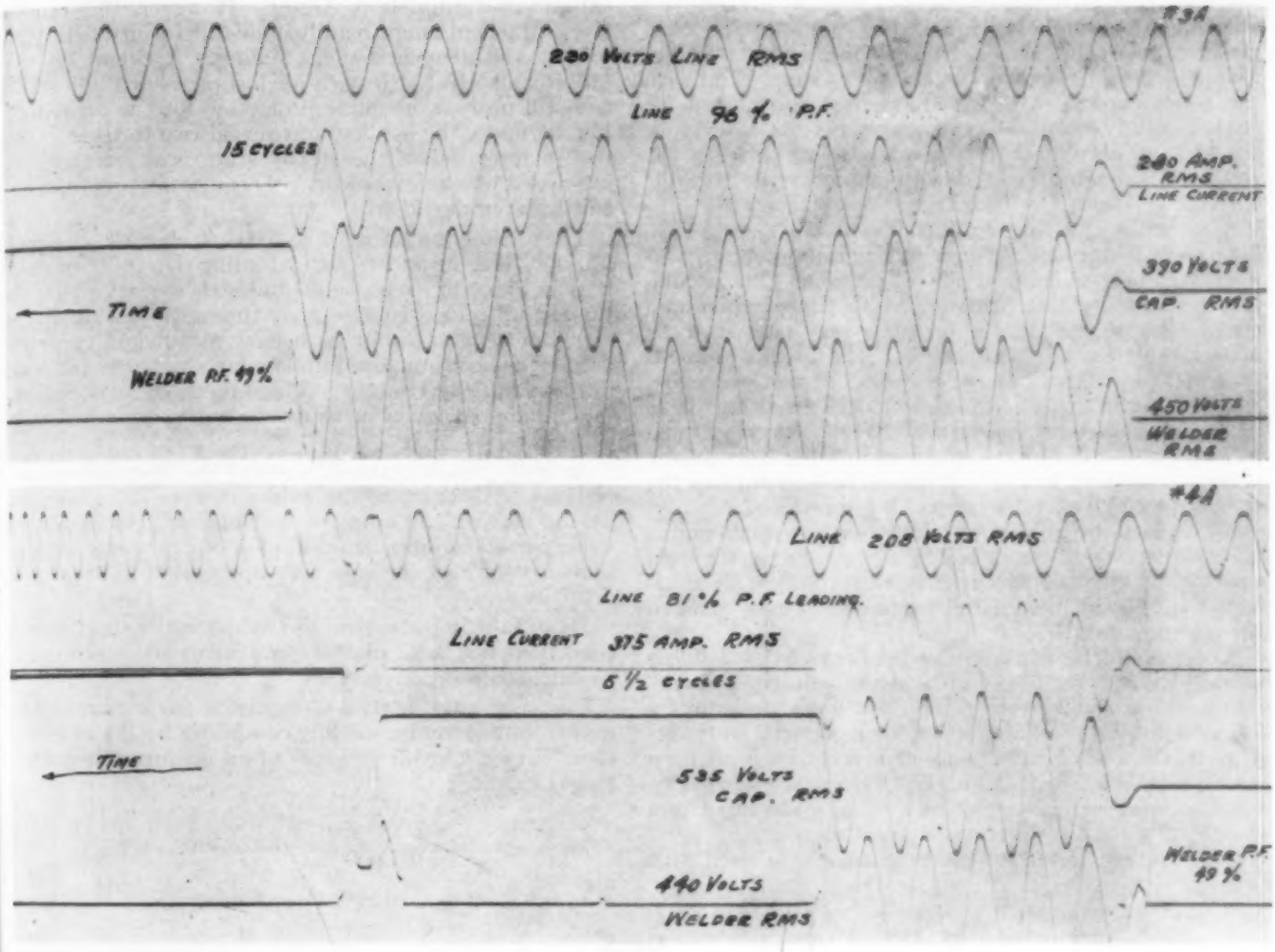


Fig. 4

there is insufficient iron in the standard transformer to limit the voltage impressed on the capacitors to the maximum permissible. We have the choice of altering the transformer or supplying a circuit breaker for protection. Either will cost approximately $115* which added to the above items makes a total of $1106.

This above equipment is limited to 44% duty cycle.

In order to use electronic controls instead of the magnetic contactor and automatic timer, the conditions will have to be recalculated to allow for the 15 v. ignitron tube drop.

Welding Conditions:

$\frac{65{,}000 \text{ W.}}{(230 - 15)} = 302$ amp., $\frac{(230 - 15)}{0.5} = 430$-v. welder.

$430 \times 0.866 = 372$ v. capacitor, $\frac{372 \text{ v.}}{302 \text{ amp.}} =$ 1.23 ohms capacitor.

Short Circuit Conditions (using 7–8.3-ohm capacitor units):

$\frac{(230 - 15)}{0.49} = 439$ amp. 439 amp. $\times 1.45 =$ 637 v. transformer.

$439 \times 1.19 = 522$ v. capacitors.

This is below the maximum permissible voltage rating of the capacitors. The root mean square voltage impressed on the ignitron tubes of the control will equal the capacitor voltage, 372 v., plus the line voltage, 230 v., equals 602 v. The root mean square ignitron tube kilovolt ampere load equals 602 v. multiplied by 302 amp. equals 182 kilovolt ampere. The manufacturer's ignitron tube rating curves for use with series capacitors recommends size "B" ignitron tubes.

An ignitron tube contactor with heat control for use with series capacitors will cost		$1042.00*
1	Standard automatic timer (Nema 3B)	165.00*
7	8.3-ohm, 330-v. capacitors @ $90.00	630.00
1	8 unit rack and enclosure	70.00
1	Discharge resistor and contactor	50.00
We again have our choice of circuit breaker or transformer alterations		115.00*
	Total	$2072.00

This above equipment is limited to 44% duty cycle.

Fully synchronous ignitron control for use with series capacitors will cost		$1237.00*
1	Standard Sequence Panel (Nema 7B)	140.00*
7	8.3-ohm, 330-v. capacitors	630.00
1	8-unit rack and enclosure	70.00
1	Discharge resistor and contactor	50.00
Circuit breaker or transformer alterations		115.00*
	Total	$2242.00

This equipment is limited to 44% duty cycle. These costs are an exceptional case. Magnetic contactors are

not universally applicable due to the high voltages involved.

Oscillograms of both lagging (5A) and leading (4A) power factor conditions are shown for study. Oscillogram (1A) of welding with 440 v. power supply and with the series capacitors short circuited is also shown for study. Study of these oscillograms reveals a surge of voltage and current that varies depending on when the magnetic contactor is closed with respect to the 60-cycle current.

The oscillograph 3A welding 0.093 in. C.R.S. at a 96% line power factor lagging shows current and voltage relations very near to those of our calculations. The oscillograph 1C for welding 0.064 in. 24 ST Alclad aluminum shows current and voltage relations very near to those of our short circuit calculations. The oscillograph 8C of actual short circuit shows current and voltages somewhat higher than those of our calculations. This is to be expected when using a standard 440-v. 60-cycle transformer that does not have sufficient iron for 700 primary volts. This high welder voltage partially saturates the transformer and thereby reduces its impedance.

All three of the welds shown in these three oscillograms were made with the same welder setting except for weld time. The changes in currents and voltages were affected merely by the change of the resistance between the electrode tips.

Note should be made in the oscillograms of welding steel of the varying slope of the rising voltages and currents. This slow rise in current and voltage requires a longer weld time than usual for a given material and gage. This tends toward more consistent welding from nonsynchronous controls. (One cycle inaccuracy in 5 cycles is 20%; one cycle in 8 cycles is $12^1/_2$%.) The capacitors also tend to iron out the transients and surges.

Over-voltage protective equipment could be used with electronic control to prevent the high voltage on the capacitors during short circuit. However, this protective equipment is not readily available for magnetic contactors and nonsynchronous timing. A circuit breaker (approximately $115) with an instantaneous adjustable trip will provide adequate protection for the capacitors. Furthermore, the oscillograms reveal two to three cycles time elapses before the steady state peak voltages are impressed on the capacitors. During this time, the circuit breaker should trip.

The oscillogram 5A welding 0.093 steel at 89% lagging, 3A, 96% lagging and 4A, 81% leading power factor show that in order to make welds under these varying conditions, the welder voltage goes through a maximum at 100% power factor but both line current and capacitor voltage rise continually from low-lagging power factor to low-leading power factor. These facts are most important in the design of a transformer for use with series capacitors.

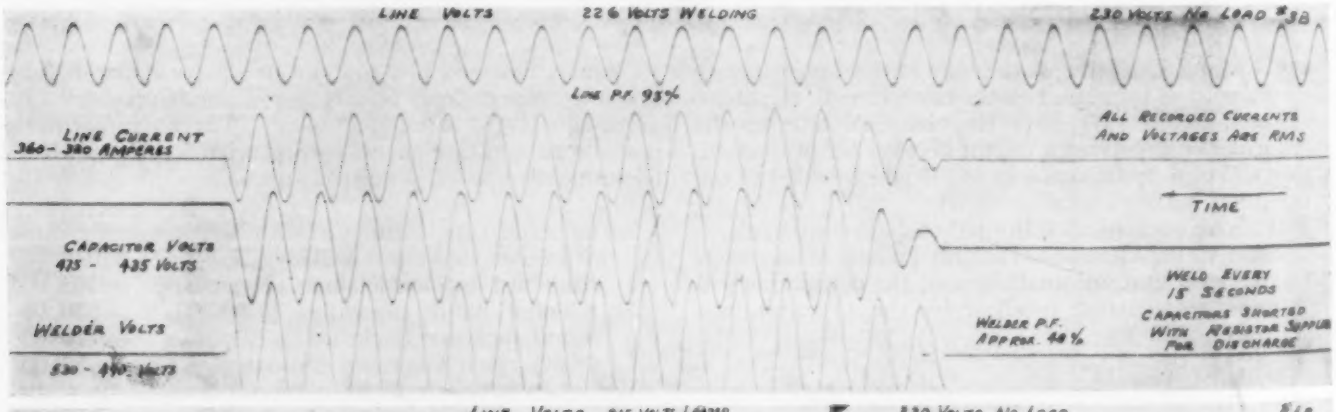
Actually, oscillogram 8C showed the short circuit impedance to be equal to the welder voltage 750 v. divided by the current 530 amp. = 1.42 ohms. The 1.45 ohm value for welder impedance used in our previous calculations is correct if the iron core is operated at lower flux densities.

Should the impedance of the welder under short circuit conditions not be available approximations can be made by calculations.

One suggested method is to divide the square of the welder voltage under welding conditions by the expected short circuit kilovolt amperes of an uncorrected welder. In our case:

$$\frac{460 \times 460}{160{,}000} = 1.32 \text{ ohms.}$$

Fig. 5


LINE VOLTS
226 VOLTS WELDING
230 VOLTS NO LOAD #3B
LINE P.F. 93%
ALL RECORDED CURRENTS AND VOLTAGES ARE RMS
LINE CURRENT 360 - 380 AMPERES
TIME
CAPACITOR VOLTS 425 - 435 VOLTS
WELD EVERY 15 SECONDS
CAPACITORS SHORTED WITH RESISTOR SUPPLIED FOR DISCHARGE
WELDER P.F. APPROX. 48%
WELDER VOLTS 530 - 490 VOLTS

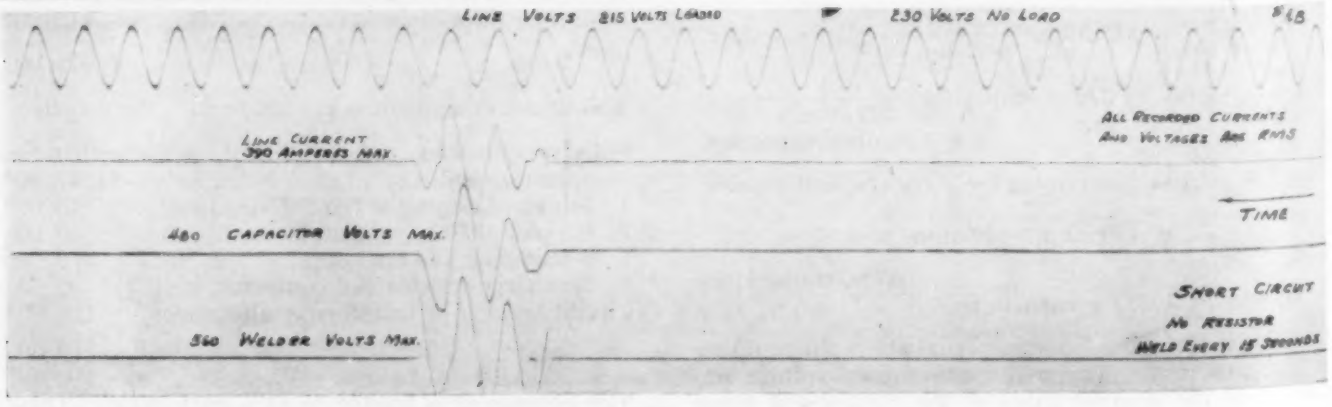


Fig. 6

Fig. 7

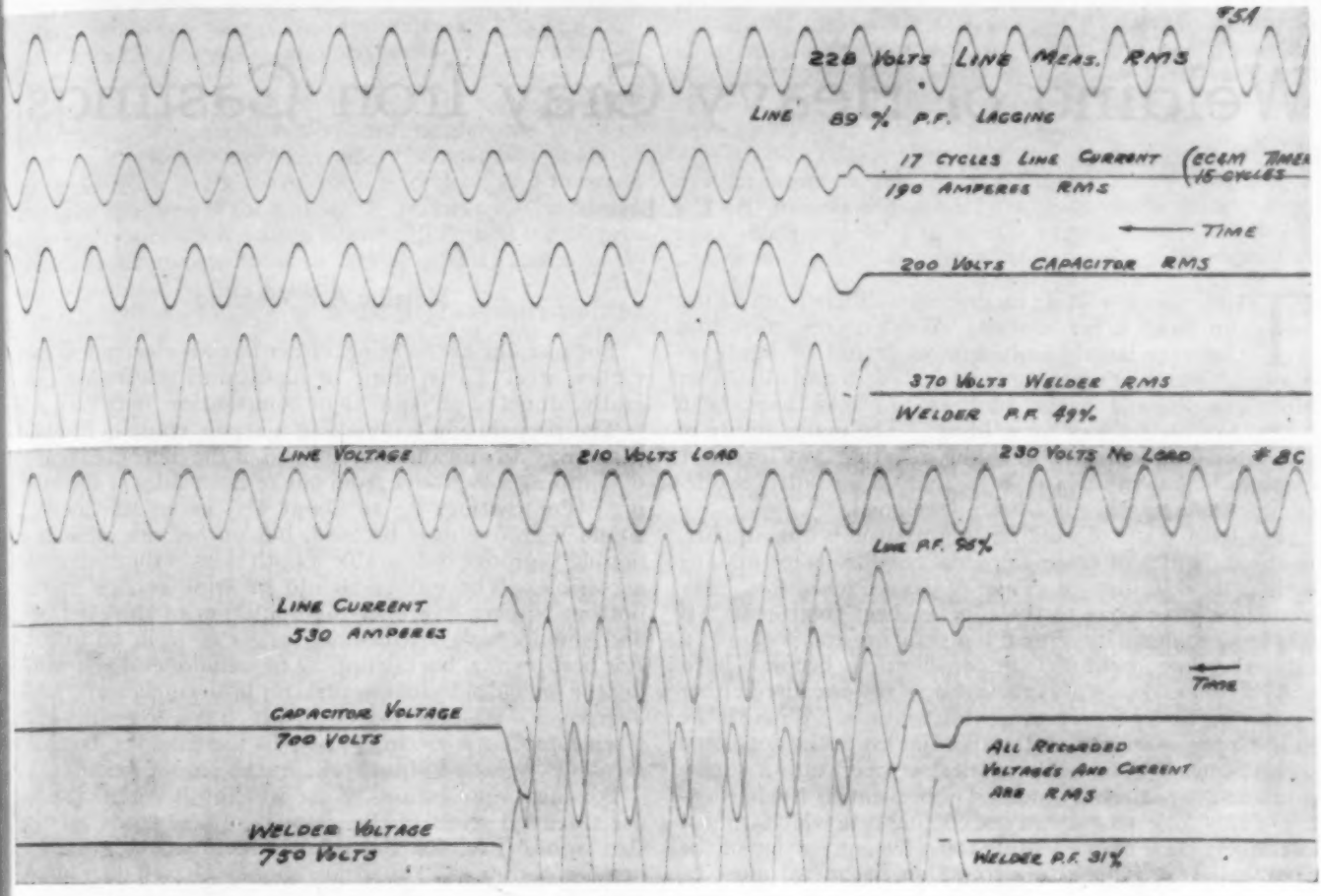


Fig. 8

This is not a very close approximation in this example, but is a safe one.

As an alternate method, we could assume that the inductive reactance of the welder remains the same for short circuit as for welding steel. The welder impedance on short circuit would then equal the welder reactance, 1.35 ohms divided by the sine of the power factor angle on short circuit, 0.95, equals 1.42 ohms. In this example, the resulting impedance is correct but this is not always true for different conditions.

Oscillogram 4B illustrates how a circuit breaker may be used to open the power supply when the electrodes are accidently short circuited. The welder conditions are the same as those illustrated on oscillogram 8C for a continued short circuit for 8 to 9 cycles. Although the short circuit of oscillogram 4B persisted for three cycles, the circuit breaker opened before objectionaole voltages were reached. An accidental short circuit is revealed on oscillogram 4A.

Oscillogram 3B reveals that the magnetic contactor bounced on closing and thereby produced considerable more surge than produced by positive contactor closing as illustrated in oscillogram 3A. Welding conditions were also altered slightly during oscillogram 3B with respect to oscillogram 3A.

Series capacitor applications are often described as limiting the range of usefulness of the welder with which they are applied. This is seldom true. In the case of the application illustrated in our calculations and oscillograms, the usefulness of the welding machine has been extended.

Furthermore, we are able to weld 2 pieces 0.093-in. cold rolled steel with a demand of approximately 65 kva. as compared to 130 kva. for welding the same work on the same welder without the series capacitors. We are also able to weld 2 pieces of 0.064-in. aluminum alloy with a demand of approximately 104 kva. as compared to 350 kva. required for an uncorrected welder. Not this same welder, because without the series capacitors, this welder will not deliver 350 kva. If this welder is used to weld this aluminum alloy, the series capacitors will be paid for in approximately 4 to 6 months in reduced demand charges only. Series capacitors do not always pay for themselves, but it always pays to investigate and find out what can be done.

* Note: Welder control prices are currently increased.

Welding of Heavy Gray Iron Castings*

By L. J. Larson†

THE use of welding on gray iron differs from its use on most other metals. Welding on gray iron has been largely limited to repair and salvage operations although in some cases pads, bosses and also other more complicated parts, such as brackets, have been added to iron castings by welding. The manufacture of gray iron structures by welding together two or more castings is not common practice and, as a result, production procedures have not been developed.

The limited use of welding on gray iron is due, in part, to the difficulty of achieving ideal conditions for making satisfactory welds. Because of its composition, gray iron is very sensitive to the effect of heat treatment. If it is heated above its critical temperature and cooled at a rate exceeding about 600° F. per minute it becomes hard and brittle, and is easily cracked by stresses caused either by loading or by temperature differentials. With all the welding processes, the materials adjacent to the deposited metal is heated above the critical temperature for gray iron and hence the only method of preventing the hardening of this zone is to retard the cooling rate which is most effectively done by preheating the adjacent portion of the casting. The temperature to which the metal must be preheated and the size of the preheated area depend upon a number of factors such as the welding process to be used and the size and shape of the casting. Although specific rules governing all cases cannot be given, the following general principles will serve as a guide when repairs of maximum strength are desired: (1) Heat the surface on which metal is to be deposited sufficiently to obtain a good bond between the weld and the parent metal, (2) heat the area adjacent to the repair sufficiently to prevent hardening in the weld zone and (3) heat other parts of the casting in such a manner that excessive stresses will not be caused by the welding operation. A general preheat to a high temperature, about 1000° F., would meet all of above requirements but such a preheat is seldom possible on large castings. Furthermore, the welder would not be able to work on the castings at this temperature. A compromise is therefore necessary and a lower general preheat with or without local high temperature preheat is used.

For repairing gray iron castings a number of methods have been successful. Among these are:

1. Metallic arc welding.
2. Oxyacetylene welding.
3. Carbon arc welding.
4. Bronze welding.
5. Thermit welding.
6. Burning.

Each method has certain advantages and certain disadvantages and the particular process to be used depends upon circumstances. Sometimes two or more processes may be used on the same casting.

Metallic Arc Welding

For metallic arc welding, either ferrous electrodes, low-carbon steel or cast iron; or nonferrous electrodes, generally Monel or an equivalent composition, may be used.

The preparation for making a repair consists of chipping away any unsound metal and, if the defect is a crack, of chipping a V-groove from one or both sides of the casting. For castings up to about $1^1/_2$ in. in thickness, a single V-groove may be used, but on heavier sections a double V-groove is desirable if both sides of the casting are accessible. The groove should be wide enough at the bottom to permit proper manipulation of the electrode and should have an included angle of from 60 to 90°. For best results, back-chipping to sound metal and welding the second side are essential for both single and double V-grooves. A shear V-groove, which is a V-groove with a wide top, is sometimes used to increase the bonding area between the weld metal and the parent metal.

For most applications of arc welding it is desirable to use threaded studs in the groove. These studs vary in size from $^1/_8$ in. for the thinner sections to $^1/_2$ in. for heavier sections. The studs should be well distributed over the surface of the groove or weld area and spaced about $^1/_2$ in. for the smaller studs and up to 2 in. for the larger studs. To make the studs fully effective care must be taken to obtain good fusion around and onto them, thus attaching the weld metal securely to the studs which, in turn, are anchored into the cast iron below the heat-affected zone. Without the use of studs, arc welds may pull away from the parent metal as shown in Fig. 1. Cracks such as those shown in this specimen generally occur in the heat-affected area and are not due to lack of fusion between the weld metal and the cast iron.

With the metallic arc process, preheating of the base metal in order to obtain fusion between it and the deposited metal is not required but hard spots in the weld area will occur if preheat is not used. Figure 2 shows the results of hardness surveys on single bead welds made with two ferrous and two nonferrous electrodes, with no preheat, and with 500° F. and 1000° F. preheats. The curves at the left show the hardness in the heat-affected zones and those at the right, the hardness of the weld deposits.

As might be expected, all of the electrodes produce high hardness in the heat-affected zones when no preheat is used. The values are somewhat higher for the ferrous

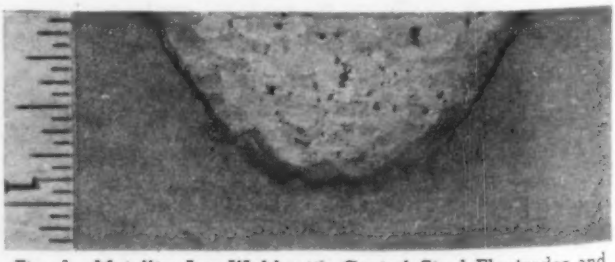


Fig. 1—Metallic Arc Weld with Coated Steel Electrodes and No Preheat. × 1

* Delivered before 50th Annual A.F.A. Convention, Cleveland, Ohio, May 10, 1946.

† Welding Engineer, Engineering Development Division, Allis-Chalmers Mfg. Co., Milwaukee, Wis.

than for the nonferrous types of electrodes but the difference is not great. At a preheat of 500° F. the hardness values, with one exception, are between 245 and 275 Brinell for all electrodes, and at the 1000° F. preheat, all hardness values are below 160 Brinell.

The hardness values of the weld deposit show a marked difference between the ferrous and nonferrous types of electrodes. With steel electrodes the hardness is above 400 Brinell for preheats of 500° F. or less, and between 190 and 225 Brinell for a 1000° F. preheat. The Monel type electrodes show values below 210 Brinell for all preheats except one electrode at 500° F., which has a maximum hardness of 320 Brinell.

With multipass welds, both the weld deposits and the heat-affected zones are softened materially by the heat of subsequent layers but this does not eliminate the danger of cracking in the hardened areas before the next layer is deposited. Even with a preheat of 500° F., multipass welds made with either ferrous or nonferrous electrodes may develop cracks as is shown in micrographs, Figs. 3 and 4.

To determine their strengths, welds of several types were made in standard gray iron castings such as that shown in Fig. 5. This shape of casting was chosen because it offers partial restraint to the shrinkage of the weld and thus simulates to some extent the condition encountered in making repairs. The strength values for the welds were obtained from tension specimens located as shown in the upper part of Fig. 6. The numerical values shown in the lower part of Fig. 6 apply only to a particular bronze weld.

Metallic arc welds were made with ferrous and with nonferrous electrodes with no preheat and with a preheat of 500° F. Since it was desired to determine the strength of the junction of the weld to the cast iron, no studs were used.

With no preheat the welds pulled away from the cast iron as shown in Fig. 1 and no tension tests were made. With a preheat of 500° F , the weld made with the ferrous electrodes had a tensile strength of 11,000 psi. across the junction and 49,000 psi. for the deposited metal. The corresponding values for the weld made with the nonferrous electrodes were 12,200 psi. and 70,000 psi., respectively.

Metallic arc welds were not made with a preheat of 1000° F. since other welding processes are generally preferred if this amount of preheat is permissible.

Although metallic arc welds made without preheat are not reliable for joints requiring high strength, the process is useful on structures in which distortion must be kept at a minimum. An example of the successful use of this process is furnished by the repairs on cast-iron cylinders of low-pressure steam turbines. In many installations corrosion of the cast iron between the blade grooves occurs to such an extent that the support of the blades is impaired. In some instances this corrosion becomes serious in a period of one or two years. The corroded areas may be built up by welding but it is necessary to prevent

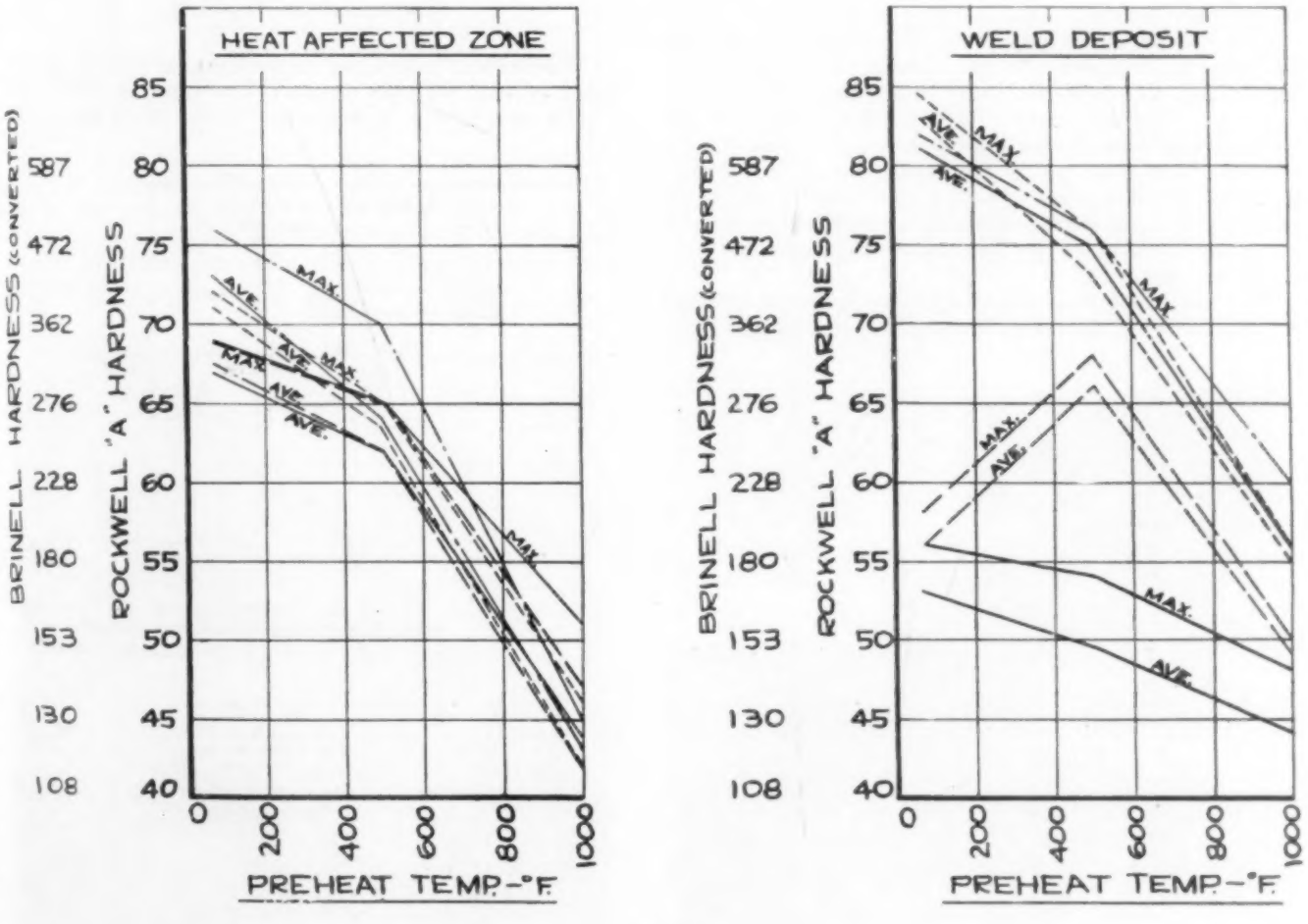


Fig. 2—Curves Showing Hardness Values of Single Bead Metallic Arc Welds

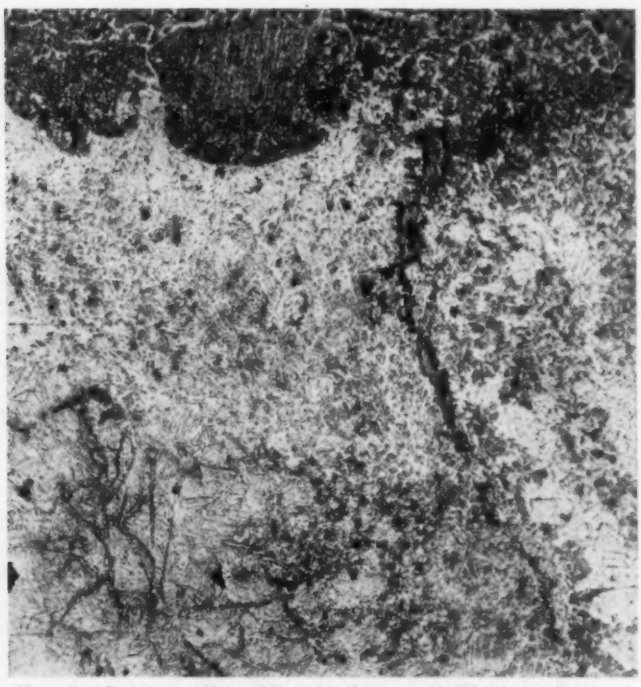


Fig. 3—Crack in Heat-Affected Area and Weld (at Top) of Metallic Arc Weld, with Steel Electrodes and 500° F. Preheat. × 100

distortion of the cylinder which would render it useless for further service. Arc welding with lightly coated Monel electrodes, without preheat, has been adopted for making these repairs. Screw studs of $^1/_8$ in. diam. have been used. By depositing only short beads and skipping around to different parts of the cylinder, difficulties due to distortion have been eliminated. This method of repair has been particularly successful because the Monel deposits are so resistant to corrosion that it has never been necessary to reweld any of the cylinders even though some have been in service for over twenty years since the repair was made.

When the distortion resulting from a moderate preheat is not serious but the high preheat required by other welding processes is objectionable, metallic arc welding with a preheat of about 500° F. may be used. This results in a repair with sufficient strength for many structures, especially if studs are used. Such welds, made with nonferrous electrodes, are also machineable.

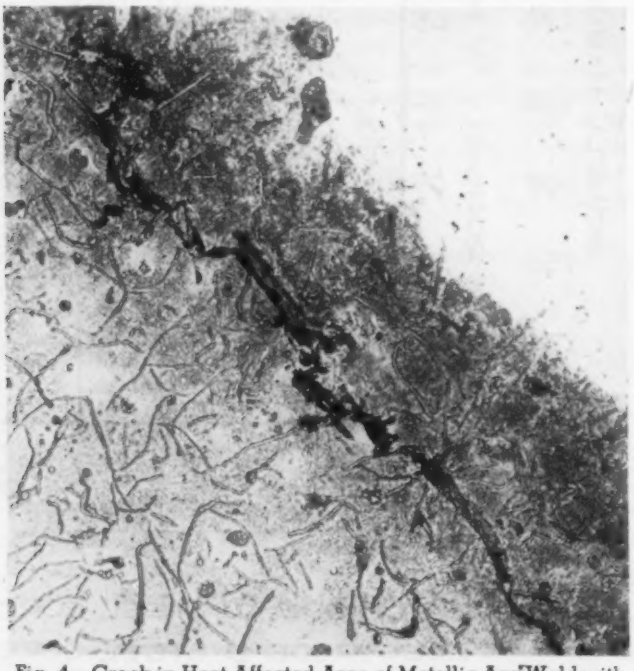


Fig. 4—Crack in Heat-Affected Area of Metallic Arc Weld with Monel Electrodes and 500° F. Preheat. × 100

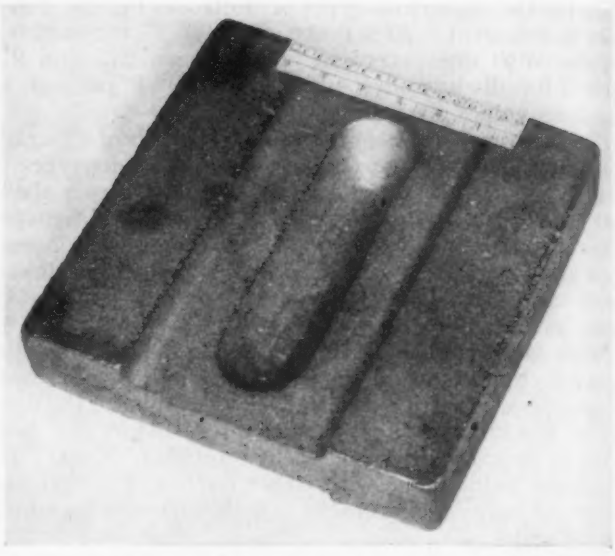


Fig. 5—Cast-Iron Plate Used for Welding and Brazing Tests

Oxyacetylene Welding

Oxyacetylene welding or gas welding, as it is frequently called, is done with the oxyacetylene torch adjusted to a neutral or slightly carburizing flame. Cast-iron filler

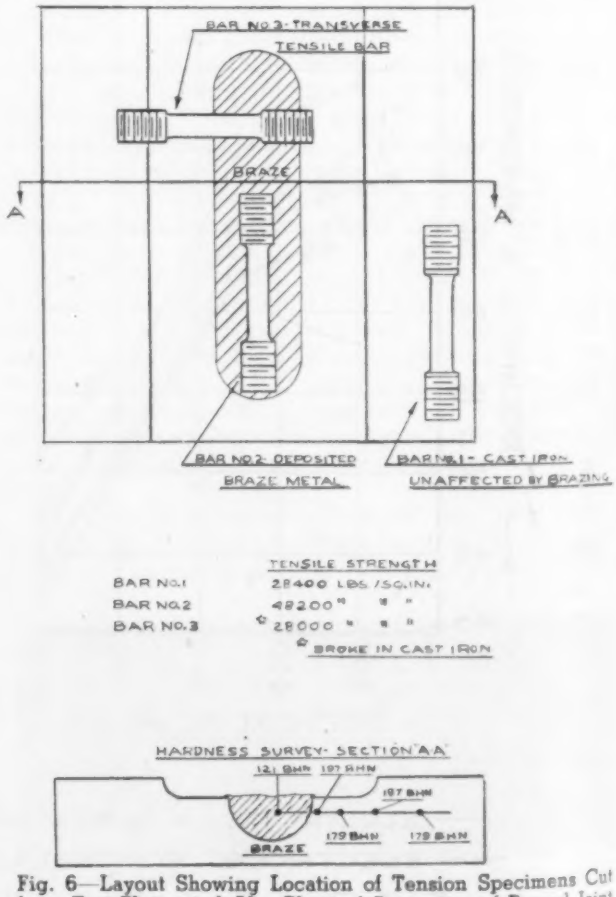


Fig. 6—Layout Showing Location of Tension Specimens Cut from Test Plates and Also Physical Properties of Brazed Joint

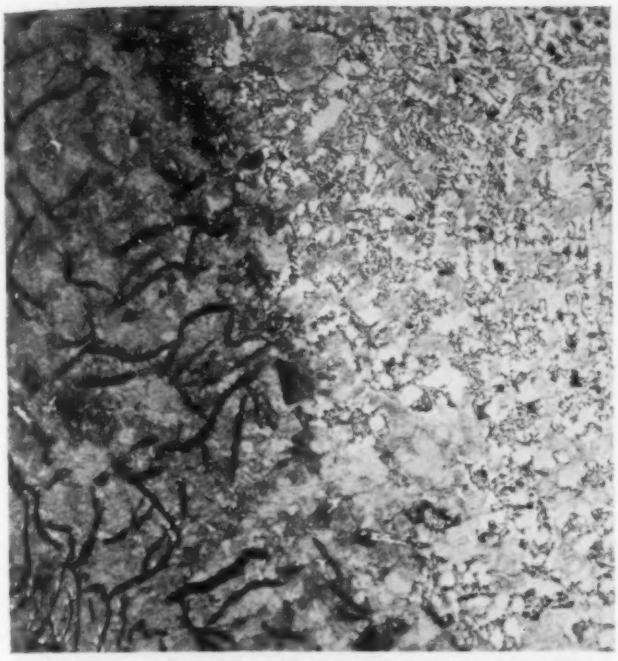


Fig. 7—Oxyacetylene Weld (Right) with Cast-Iron Filler Wire in Gray Iron Test Plate. × 100

rods having about 3.5% carbon and 3.0% silicon are suitable and a cast-iron welding flux is used.

For repairing cracks in castings, a V-groove similar to that used for arc welding is prepared. The groove need be only wide enough to permit proper manipulation of the welding torch and studs are unnecessary.

The parent metal around the weld area is generally heated to 1000° F. or more to speed up the welding operation. This may be done with a charcoal fire or with large gas or oil burners. Hardening is not a problem in the case of gas welding since the heat required to obtain proper fusion will raise the temperature of the adjacent metal sufficiently to prevent the weld area from cooling faster than the critical rate.

Fig. 8—Junction of Bronze Weld in Gray Iron. Good Brazing Procedure. × 25

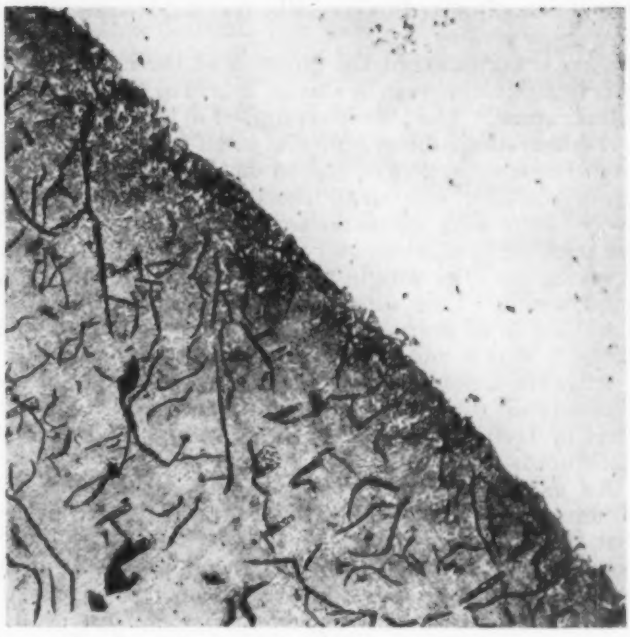


Fig. 9—Junction of Bronze Weld in Gray Iron. Good Brazing Procedure. × 100

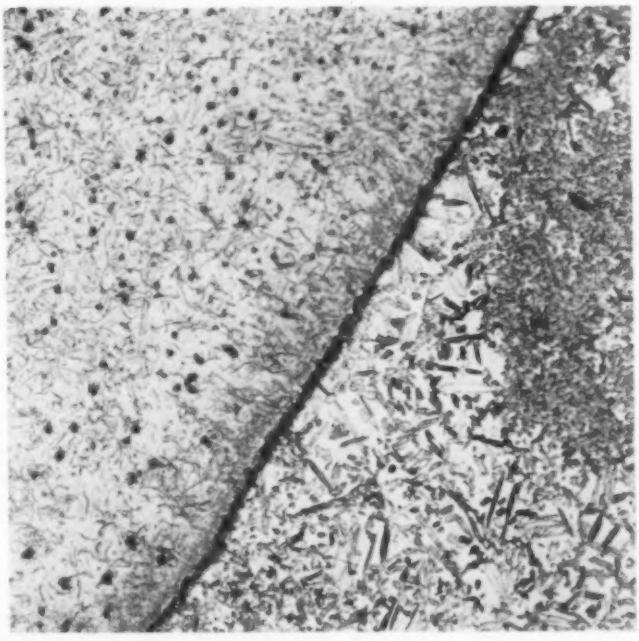


Fig. 10—Junction of Bronze Weld (Left) in Gray Iron. Improper Tinning Procedure. Note Oxide Film at Junction. × 25

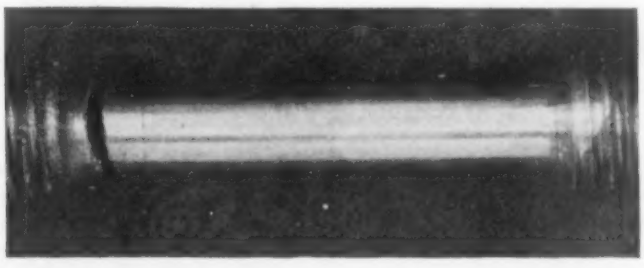


Fig. 11—Ruptured Transverse Tension Specimen from Bronze Weld

The size and shape of the preheated area are determined by the shape of the structure being repaired, the object being to heat it in such a manner that the structure

will not be subjected to excessive thermal stresses during heating or cooling.

Flux is sprinkled in the groove and the local area at which the welding is to be started is heated to the melting temperature. The filler wire, dipped in flux, is heated to a red heat and rubbed onto the fused area. With continued heating, a pool of molten metal is formed and the tip of the filler wire should be kept submerged in this pool. If the filler wire is melted and allowed to drop into the pool, slag inclusions and porosity are likely to result. Working the filler wire in the molten pool helps to float out the slag. Care must be taken to melt the parent metal ahead of the molten pool in order to obtain good fusion. Flux is added as the welding progresses.

After the welding is completed the structure should be covered so as to cool slowly. Stress-relieving at temperatures of 1100 to 1200° F. is beneficial, especially if the structure is rigid.

An oxyacetylene weld, properly made, will have a structure very similar to that of the parent metal except that the grain size is smaller. Figure 7 shows the junction between an oxyacetylene weld and gray iron. The strength of the deposited metal corresponds to that of cast iron of a similar analysis and if the welding procedure has been carried out so as to obtain proper fusion, the joint will have a strength approximately equal to that of the parent metal.

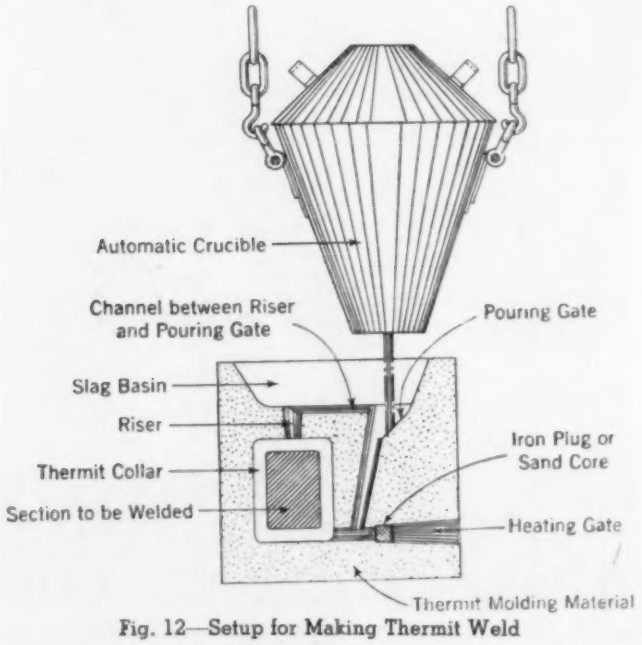


Fig. 12—Setup for Making Thermit Weld

Oxyacetylene welds with cast-iron filler rod have the same color as the parent metal, which is sometimes important especially when the repair is machined.

Carbon Arc Welding

Although this is an arc welding process it resembles oxyacetylene welding since the same type of filler wire and flux are used. It differs from the gas welding process in that an arc between carbon or graphite electrodes and the work is used to furnish the heat necessary for making the weld.

Inasmuch as the heat of the arc is sufficiently intense to melt the parent metal without difficulty, preheating is not required in order to obtain fusion. However, preheating is necessary to prevent the heat-affected area from hardening and cracking just as in the case of metallic arc welding. The weld area should be heated to about 1000° F. and the surrounding area heated sufficiently to prevent excessive temperature stresses. After the weld is completed the casting should be covered so as to cool slowly.

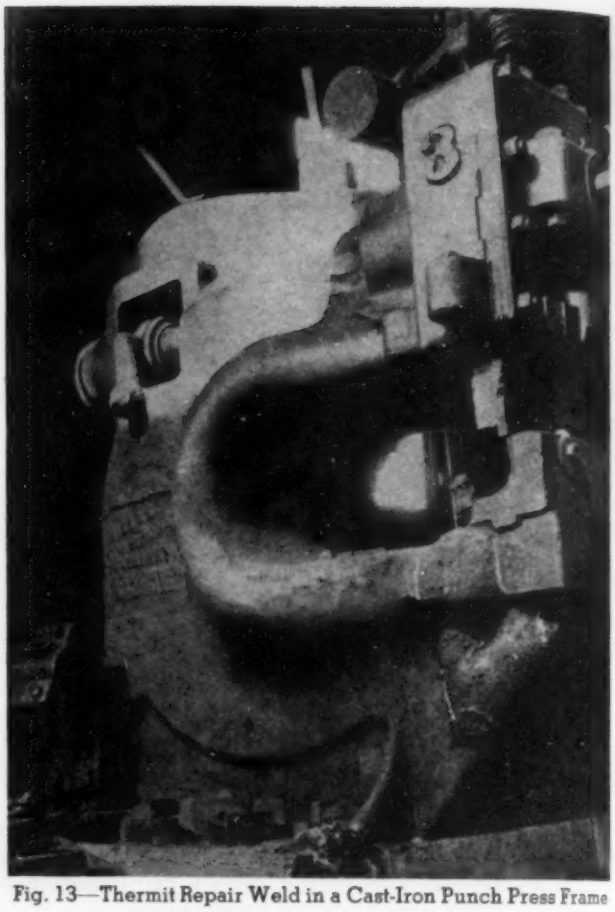


Fig. 13—Thermit Repair Weld in a Cast-Iron Punch Press Frame

Welds made by this process will be easily machineable and the color of the weld metal will be the same as that of the casting. If the welding is done properly the strength of such welds will be satisfactory but it is more

Fig. 14—Thermit Weld Joining Two Sectiong of Large Cast-Iron Roll

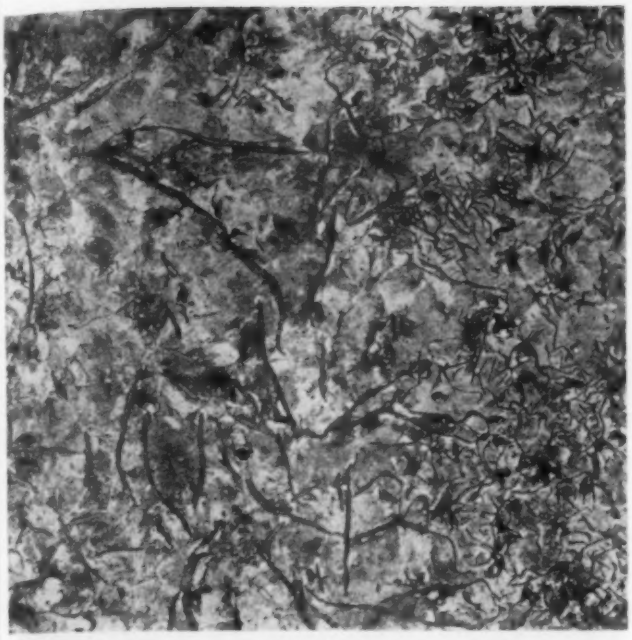


Fig. 15—Junction of "Burn" Metal (Right) and Gray Iron. × 100

difficult to control this welding procedure than the gas welding process.

Bronze Welding

Bronze welding or brazing is very similar to gas welding except that a brass filler wire containing approximately 60% copper and 40% zinc is used in place of the cast-iron filler wire. The oxyacetylene flame adjusted to be slightly oxidizing is used as a source of heat. It is recommended that two types of flux be used, a "tinning" flux for coating the surface of the cast iron and a welding flux for the remaining brazing operation. These fluxes are commercially available.

For repairing cracks in castings, a V-shaped welding groove, similar to that used for arc and gas welding, is used. This groove should be chipped rather than ground because grinding tends to coat the cast iron with graphite which interferes with the brazing process. Cleaning with a wire brush is helpful and excess graphite may also be burned off with an oxyacetylene torch adjusted to an oxidizing flame.

The weld area is preheated by any convenient means in order to speed up the welding operation. As in the case of oxyacetylene welding, the bronze welding operation develops sufficient preheat in the material adjacent to the welding groove to prevent hardening of the heat-affected area.

Some of the tinning flux is sprinkled into the groove and a small area at the point where the weld is to be started is heated to a temperature slightly above the melting temperature of the brass filler rod, which is about 1650° F.

The behavior of the brass on the cast iron indicates when the proper temperature has been reached. If the cast iron is too cold, the brass does not spread out or "tin" the surface, and if the temperature of the iron is too high the brass collects in little balls on the surface of the cast iron. The fact that bronze welding is done at a temperature of several hundred degrees below the melting point of cast iron is an advantage in favor of bronze welding.

The welding groove must be tinned with brass ahead of the weld to insure that the deposited metal will not be cast in the groove without fusion. When tinning is properly done the brass penetrates between the grains of the iron as shown in Fig. 8 at 25 × and also in Fig. 9 at 100 ×. The result of improper tinning is shown in Fig. 10 at 25×. It will be noted that in this case there is not only a lack of intergranular penetration of the brazing material but there is an oxide film between the two surfaces. Obviously, under this condition, a satisfactory joint is not obtained. After the groove is tinned, the weld is built up in layers until complete and the casting is then covered and allowed to cool slowly.

A bronze weld, properly made, results in a repair which is as strong as the casting. As may be seen from values given in Fig. 6 the bronze deposit had a tensile strength considerably greater than that of the gray iron and the transverse specimen had a strength equal to that of the parent metal. Figure 11 shows the transverse specimen with the weld at the right and the fracture at the left about two inches from the edge of the weld.

From the standpoint of strength, bronze welding is one of the best methods of repairing gray iron and the chief objection to this method of repair is that the color of the weld does not match that of the parent metal.

Thermit Welding

The Thermit welding process for gray iron is similar to that for steel except that a cast-iron Thermit mixture is used for gray iron. The process is used for making repairs on many types of structures but is not suitable for welding long cracks in thin sections or for welding cracks which extend only partially through a section. However, in the latter case, it may be feasible to cut the remaining portion of the section and make a complete weld. According to the Metal and Thermit Corporation's recommendations, the process should not be attempted if the length of the crack exceeds about eight times the thickness of the material because the shrinkage of Thermit iron is about twice that of gray iron and transverse cracks are likely to develop when the length of the section is too great in proportion to its thickness. If the section is compact there is practically no limit to the size of sections which can be successfully welded.

The preparation for Thermit welding is simple. The ends of the broken member are machined or otherwise cut so as to form a parallel-sided gap at the section which is to be welded. The width of the gap increases with the size of the section and tables are available showing the proper gap for various cross sections. After the preparation is completed, the broken pieces are set up in alignment with proper allowance for shrinkage and a wax pattern is made to conform to the desired shape of the finished weld. A mold box of suitable size is then set in place around the broken member and this is filled with Thermit molding material with the various gate and riser

Fig. 16—Four-Section Cast-Iron Water Box on 40-Ft. Mill for Machining

patterns in their proper positions. After the molding material has been rammed in place the patterns are removed. Figure 12 shows a typical setup for making a Thermit weld.

When the mold has been completed the ends of the casting next to the gap are preheated to a red heat with a kerosene-air burner through the gates provided for that purpose. The preheating melts out the wax pattern. In the meantime the pouring crucible is set in position above the mold and the correct amount of Thermit mixture is placed in the crucible. When the preheating is completed, the preheating gates are plugged and the Thermit mixture is ignited with a special powder. The time of the Thermit reaction is independent of the amount of Thermit metal in the crucible and is about thirty seconds. As soon as the reaction is completed, the crucible is tapped and the molten metal flows into the space formed by the wax pattern while the slag from the reaction fills the slag basin in the mold. The superheat in the Thermit metal is sufficient to melt some of the iron adjacent to the gap, thus insuring a bond between the added metal and the original casting.

The Thermit metal is a little harder and tougher than the original gray iron but the joint can be machined. Welds made by this process have low locked-up stresses and stress-relieving is not necessary unless the repaired member is a part of a frame or rigid structure. Thermit welds made on gray-iron sections suitable for the process have shown very satisfactory service records. Figure 13 shows a Thermit repair weld in a press frame and Fig. 14 shows the fabrication by Thermit welding of a long cast-iron roll from two sections.

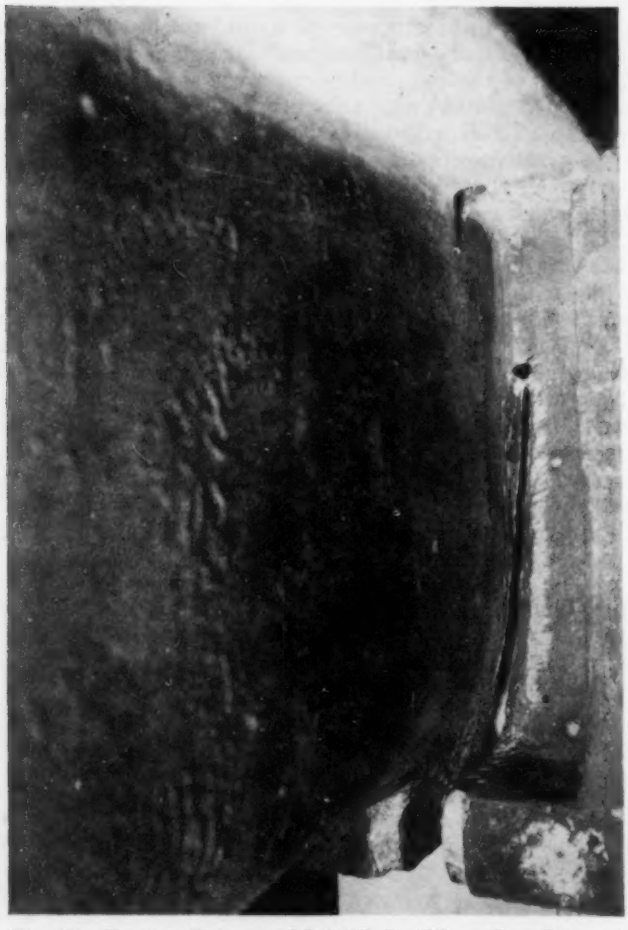


Fig. 17—Crack in Flange and Side Wall of Water Box, Chipped for Bronze Welding

Fig. 18—Bronze Repair Weld of Crack Shown in Fig. 17

Burning

Although "Burning" is generally not classified as a welding process it is one of the accepted methods of repairing gray-iron castings and also of adding parts to finished castings. Basically, it is quite similar to Thermit welding except that the molten metal for making the burn is obtained from a cupola.

The casting is prepared by chipping or other means and placed in position so that the crack or area to be repaired is in a horizontal plane. A dam of loam sand is built up around the area so as to form a well with an opening at one end to provide flow-off for the excess metal. If the repair extends through the full thickness of the casting, refractory material is built up below the opening to retain the molten metal.

The area of the casting around the repair area is preheated to a temperature of 400 to 500° F. by a charcoal fire or other convenient means.

Molten cast iron of a suitable composition is taken from a cupola and poured onto the weld area or crack in such a manner as to heat the entire area to be repaired. The pouring is done slowly and continued from one to two minutes, allowing the excess metal to run out through the flow-off in the dam. Pouring is then interrupted for a short time, perhaps a minute, to allow the heat to soak into the casting and then resumed for a short time. This alternate pouring and waiting is continued until the area to be repaired is heated above the melting temperature and proper bonding between the added metal and the original casting takes place. The metal used for pouring should be at a temperature of about 2800° F. and the

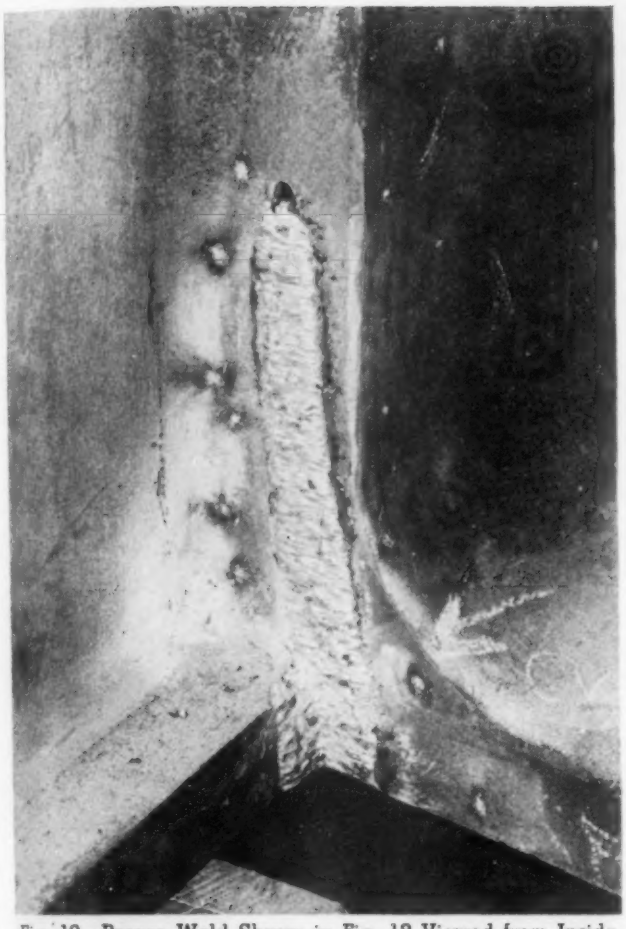


Fig. 19—Bronze Weld Shown in Fig. 18 Viewed from Inside of Water Box. Inlet Opening Appears at Right of Repair

pouring should not be done after the temperature drops below 2500° F., otherwise too much molten metal is required to heat the casting to the fusion temperature. After the pouring is completed, the casting is covered to permit slow cooling.

Physical tests of metal produced by burning show that the properties of the added metal are practically the same as those of cast material of the same analysis. The microstructure of the added metal is similar to that of gray iron except that the added metal has a finer grain structure. Figure 15 shows junction of burn metal at right and parent metal at left. If the process is properly carried out there will be no hard spots in the added metal or in the casting adjacent to the repair.

The burning process results in a repair which is similar in composition to the original casting, and therefore matches the casting in color after machining. Since the burning process requires molten metal from a cupola, its use is generally limited to repairs made in the foundry.

After completing the repairs with any of the above processes the question often arises, "Is stress-relieving necessary?" The answer depends upon several factors. Structures which are welded with the "cold" arc welding process to prevent distortion, such as the turbine cylinder discussed, cannot be stress relieved because to do so would cause distortion. Rigid structures which are welded with a high local preheat and which require high strength should be stress relieved if possible. If a structure is not rigid and the entire heated area can expand and contract freely, then stress relieving is not necessary. Many structures repaired in the field cannot be stress relieved; therefore, the metallic arc process and a moderate preheat are used even though the resulting welds do not have a strength equal to that of the casting.

An example of a large cast-iron structure which was successfully repaired by welding is the four-section, 252-in. water box shown in Fig. 16. While machining the flanges on these castings, four cracks were found at the outer corners of the sections. Three of the cracks were all the way through the thickness of the flange and one of these also extended about 14 in. in the side wall along the inlet opening. In the faces of the flanges there were a number of shrink cavities, some as deep as 2 in.

It was decided to use bronze welding for the cracks in the flanges since this would insure repairs of high strength, and color match was not important. Inasmuch as the cracks were at the corners of the sections, the expansion due to high preheat could take place without causing high stresses in the casting. Figure 17 shows the crack which extended into the side wall after chipping for welding. Figure 18 shows the outside and Fig. 19 the inside of the completed bronze weld.

The shrink cavities in the flanges were welded with the metallic arc with Monel electrodes and a low preheat. Threaded studs, $^1/_8$ in. diam. for the smaller cavities and $^1/_4$ in. diam. for the larger cavities were used. This method was chosen because these repairs are not subjected to high stresses and therefore metallic arc welds have sufficient strength and because the preheat required for the other welding processes would have produced high stresses in the side wall. Figure 20 shows one of the cavities after chipping and studding.

The sections were stress relieved after all the repairs had been completed. No difficulty was encountered in machining these sections and no trouble has developed in service.

The use of welding to repair these castings was of prime importance in several respects. Without welding it would have been necessary to replace three of the sections at considerable expense. More significant, however, is the fact that the replacement would have tied up foundry facilities needed for war production and delayed the installation of equipment which was urgently needed.

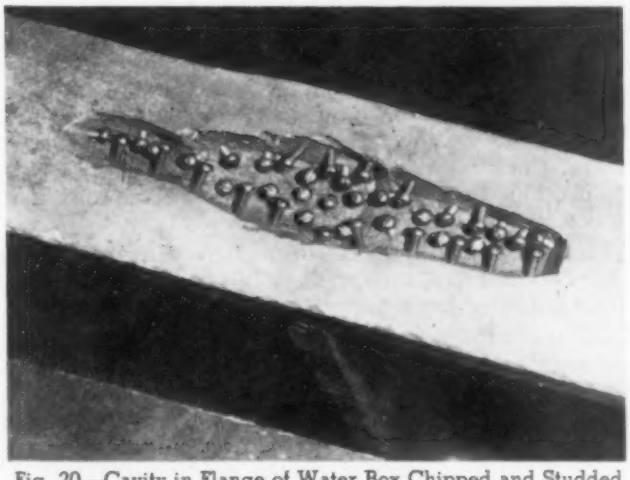


Fig. 20—Cavity in Flange of Water Box Chipped and Studded for Metallic Arc Welding

The feasibility of welding heavy gray iron castings is demonstrated by the many successful repairs which have been made. However, to insure success it is necessary to exercise good judgment in selecting the proper welding process and procedure for each application.

Acknowledgment

The author wishes to acknowledge with thanks the photographs furnished by the Metal and Thermit Corp. and the assistance of his colleagues, particularly H. O. Quartz, W. A. Hambley and G. W. Leupold in furnishing information and preparing specimens.

Rigid, Unique Water-Sphere Design Gained by Use of Electric Arc-Welding Process

By A. F. Davis*

AN ALL-WELDED watersphere, having a capacity of 40,000 gallons and designed in the shape of a giant golf ball mounted on a tall, cylindrical tee, was recently erected at the Tam O'Shanter Country Club in Chicago, Ill., by a tank building crew of the Chicago Bridge and Iron Co.

This improved design of elevated water tower, standing 86 ft. high and having a sphere diameter of 22 ft. 10 in., was completed in 25 days, including time spent pre-fabricating the curved plate sections that were hoisted into place to form the spherical ball of the tower.

The central riser extends upward through the sphere and acts as an access tube. Inside this riser there is a ladder and a 6-in. water pipe.

The employment of electric arc welding in the fabrication of this tower facilitated the unique design, afforded greater rigidity to the tank, effected a savings in material and time necessary to erect the tank.

Materials used in the fabrication of this water tank consisted of steel plates, 55,000 psi. tensile strength, which were $^{9}/_{32}$ in. thick for the lower ring of the cone; $^{13}/_{32}$ in. thick for the upper ring of the bottom cone; $^{1}/_{2}$ in. thick for the lower section of the central riser; $^{7}/_{16}$ in. thick for the upper section of the central riser; $^{5}/_{16}$ in. thick for the lower half of the sphere; and $^{1}/_{4}$ in. thick for the upper half of the sphere.

Plates comprising the watersphere and the central riser were not first tack welded, but were fitted up with Hines patented keys for positioning.

All techniques of welding were used—flat, vertical and overhead— depending on the location of the seam. The degree of penetration effected in the welding of plate sections on the tank was 100%, with two passes made to complete the outer welding, augmented by a back-up bead. However, on the welding of the $^{1}/_{4}$ in. plate on the upper half of the sphere only one outside bead was made and this was backed up with an inside bead after peening.

The plates were joined by butt-welded V-joints made with shielded arc electrodes using 200-amp. portable gasoline engine driven arc welding generators.

Erection procedure was conventional for water tank construction today and only a minimum of working days were lost through high velocity winds that prevented the hoisting of plate sections.

The hoisting equipment consisted of a gin pole boom derrick, powered by a gasoline engine unit that controlled the hoisting speed, and two hand hoists. The gin pole, equipped with a working boom, was set up inside the lower conical base of the bank.

Each of the eight base plates comprising the conical base of the watersphere were anchored to the concrete footing by two $1^{1}/_{2}$-in. bolts (see Fig. 1). The diameter of the base is 18 ft., setting on a concrete footing 21 ft. in diameter.

Fig. 1—Conical Base of the Watersphere, Mounted on a Concrete Footing

Fig. 2—The Sphere Is Constructed Around the Central Riser and Raised by the Gin Pole Boom Derrick

The watersphere is assembled around the base of the central riser and hoisted to its position atop the riser. Here (see Fig. 2), workmen are getting a curved plate section ready to be fitted and welded on the upper half of the sphere. These upper sections are $^{1}/_{4}$ in. thick and require one outside bead and one inside bead.

Three-fourths of the watersphere is joined, as can be seen in this illustration (see Fig. 3). The workman on the welding scaffold is welding the mid-section of the sphere. The final quarter section of the sphere is seen in the foreground, and it will be hoisted into place and welded when the operators have joined the third quarter onto the bottom half.

The last quarter section of the sphere is being keyed in position for welding (see Fig. 4). Hoist lines, powered by one gasoline engine unit and two hand hoists, are still attached to the section.

This illustration (see Fig. 5), shows the rise of the sphere to its position atop the central riser. The conical flange above the sphere is the lower connecting point of the sphere on the riser.

The sphere has been elevated to its final position, with the bottom plates tangent to the riser flange, and is ready for final welding. In this position, it resembles a giant golf ball mounted on a tee.

* Vice-President, Lincoln Electric Co., Cleveland, Ohio.

Fig. 3—Another View of Sphere Being Constructed Around Riser

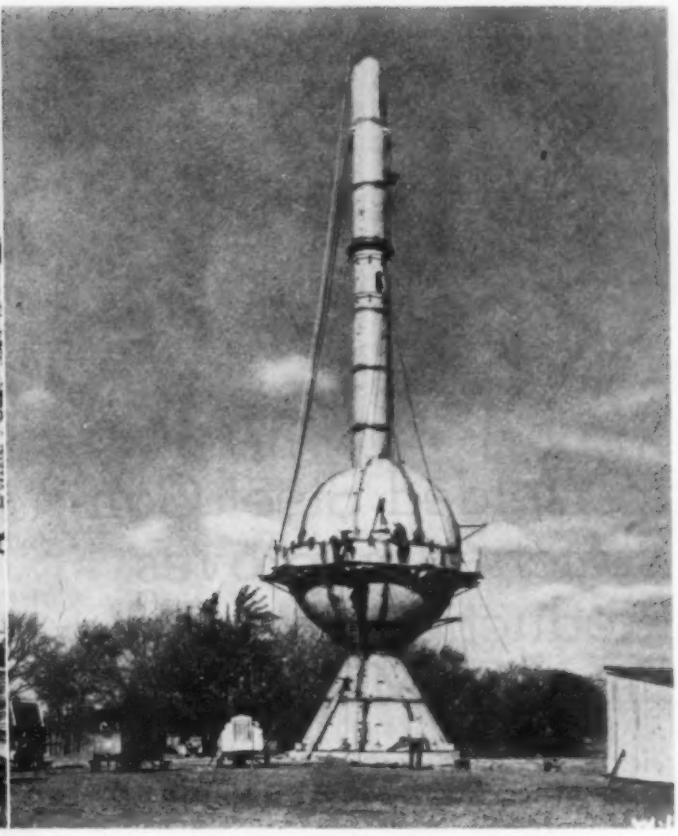


Fig. 4—Last Quarter Being Welded on the Sphere

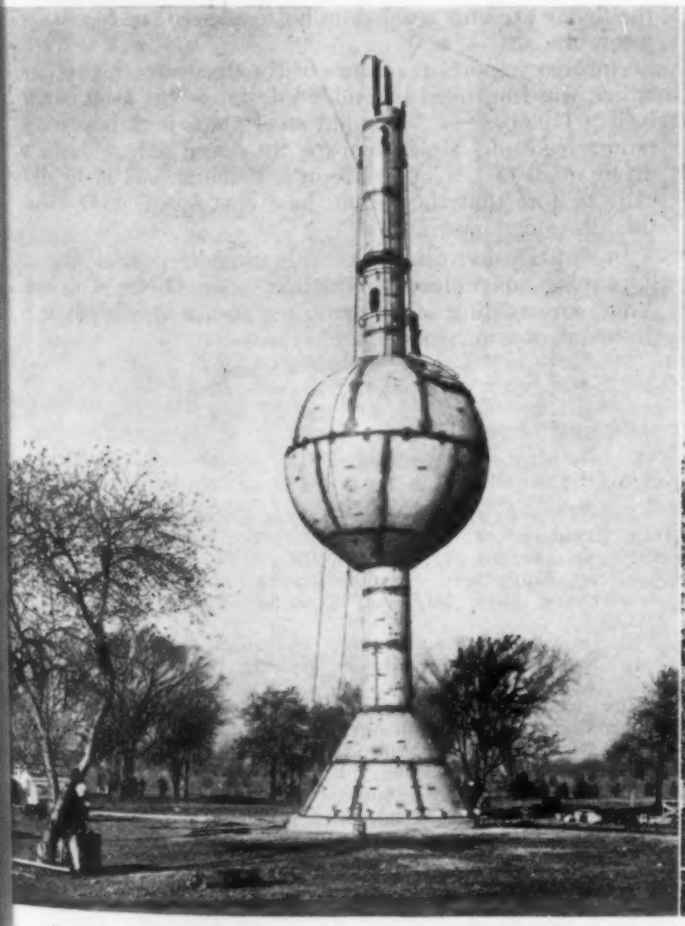


Fig. 5—Sphere Being Raised to Its Position Atop the Riser

Fig. 6—The Golf Ball on the Tee Is Ready for Action, but Welding Action It Will Be; the Bottom Plates Are Tangent to the Conical Flange on the Riser, Where the Sphere Is Joined to the Riser

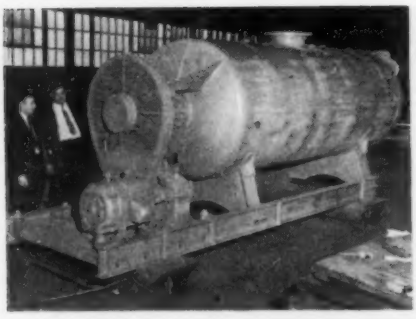


Fig. 1—Full View of the Dry Rendering Cooker. Note the Two Saddles Which Support the Cooker on the Welded Base

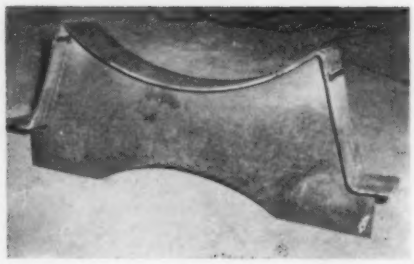


Fig. 2—View of a Completed All-Welded Saddle. Welding Brought About 27% Savings in Production Cost

Courtesy, The Lincoln Electric Co.

Fig. 3—Original Design of the Saddle Support

Arc-Welded Steel Construction Improves Production of Meat Packing Machinery

R. H. Davies*

WITH design simplicity and product improvement as major objectives, The Globe Co. of Chicago, Ill., has relied heavily on arc-welded steel construction in its program for improving machinery production in the meat packing industry.

This has been true principally because arc welding permits a flexible approach to a wide variety of problems plus the all-important fact that welded designs are strong, rigid, light in weight and have smooth, sanitary surfaces.

With the aid of welding engineers from The Lincoln Electric Co., Cleveland, Ohio, the switch to welded designs has been progressing throughout all production operations.

* Consulting Engineer, Lincoln Electric Co., Cleveland, Ohio.

A recent major change in design may be observed in Fig. 1 which shows the saddles for the dry rendering cooker. Two of these saddles support the welded pressure vessel on the welded base.

By changing to the all-welded saddle (Fig. 2), it was possible to effect a savings in production cost of 27% over the former design (Fig. 3).

The welded saddle, which is 60 in. wide, 24 in. high and 8 in. deep, is fabricated from $^1/_2$-in. mild steel plate, consisting of four pieces, flame-cut and brake formed. The parts are assembled in a welded fixture, which is placed on a work table in a flat position. After being tack welded, the assembly is removed from the fixture and the welding process is completed with the saddle positioned for the downhand welding of all joints.

This operation required continuous, two-pass fillets on both sides to join the flange to the web. The end pieces of the flange are butt welded on both sides to the top flange assembly.

Another important feature of the dry rendering cooker which was improved by welded design is the steel motor base. This base is 2-in. mild steel plate with bosses for motor feed and a platform for the speed reducer output drive, made of 1 $^1/_2$-in. plate in a V-shape. It is significant to note that the former base cost 138% more than the all-welded base.

In addition to utilizing its wide range of possibilities in improving machinery production, The Globe Co. has found arc welding of immense assistance in simplifying problems of maintenance and repair.

Current Welding Literature

Airplane Manufacture. Welding Processes at Northrop Aircraft, F. M. Burt. Welding Engr., vol. 32, no. 3 (Mar. 1947), pp. 44–49.

Automobile Manufacture. Nash Builds All-Welded Bodies, J. H. Giroux. Welding Engr., vol. 32, no. 3 (Mar. 1947), pp. 39–41, 64.

Bridges, Plate Girder. St. Rose Bridge, Canada. Engineer, vol. 182, no. 4735 (Oct. 11, 1946), pp. 316–317.

Bridges, Steel. Welded Steel Tubular Bridges. Engineering vol. 162, no. 4215 (Oct. 25, 1946), pp. 391, figs. p. 396.

Bridges, Wrought Iron. Repairing an Old Phoenix-Section Bridge to Carry Modern Loads Safely, C. A. Johnson and E. E. Seelye. Eng. News-Rec., vol. 137, no. 24 (Dec. 12, 1946), pp. 796–798.

Cars, Freight, Light Weight. Lighter and More Durable Freight Cars, A. T. Cox. Ry. Age, vol. 122, no. 12 (Mar. 22, 1947), pp. 592–593.

Electric Control. Electronic Voltage Compensators and Current Regulators, L. A. Beck. Elec. Mfg., vol. 38, no. 6 (Dec. 1946), pp. 115–118, 212, 214, 216, 218, 220.

Electric Equipment. Simplify Rotary Equipment Design with Arc Welding. Elec. Mfg., vol. 38, no. 5 (Nov. 1946), pp. 116–120, 202, 204.

Electric Motors, Manufacture. Industrial Motor Line Fabricated by Welding, Q. Graham. Welding Engr., vol. 32, no. 3 (Mar. 1947), pp. 60–61.

Electric Motors, Manufacture. Welded Design Simplifies Motor Construction. Iron Age, vol. 159, no. 12 (Mar. 20, 1947), pp. 63–64; see also Steel, vol. 120, no. 12 (Mar. 24, 1947), pp. 80–81, 112; Industry & Welding, vol. 20, no. 3 (Mar. 1947), pp. 34–36.

Electric Welding, Arc. Automatic. Submerged Melt Welding of Corrosion-Resistant Metals, R. J. Anderson and H. J. Roberts. Can. Metals & Met. Industries, vol. 10, no. 2 (Feb. 1947), pp. 18–19, 29, 34.

Electric Welding, Arc, Electrode Holders. Safety Electrode Holder for Arc Welding. Engineering, vol. 162, no. 4217 (Nov. 8, 1946), p. 438; see also Engineer, vol. 182, no. 4738 (Nov. 1) p. 402.

Electric Welding, Arc. Fabricating with Automatic Welding. Steel Processing, vol. 33, no. 2 (Feb. 1947), pp. 96–97.

(Continued on page 552)

THE AMERICAN WELDING SOCIETY

ACTIVITIES — RELATED EVENTS

1947–48 NOMINATIONS

The National and District Nominating Committees have announced the following nominations for National Officers and Directors of the AMERICAN WELDING SOCIETY. These nominations have been submitted to the membership for letter ballot vote.

President, Harold O. Hill, Asst. Chief Engr., Fabricated Steel Construction, Bethlehem Steel Co., Bethlehem, Pa.

First Vice-President, G. N. Sieger, Pres. & Genl. Mgr., S-M-S Corp., 1165 Harper Ave., Detroit, Mich.

Second Vice-President, O. B. J. Fraser, Director of Technical Service on Mill Products, The International Nickel Co., 67 Wall St., New York, N. Y.

Treasurer, R. S. Donald, Sales Engr., Thomson Electric Welder Co., 50 Church St., New York, N. Y.

Directors-at-Large (to serve for 3 years): David Arnott, Vice-Pres. & Chief Surveyor, American Bureau of Shipping, 45 Broad St., New York, N. Y.; T. M. Jackson, Electric Welding Engr., Sun Shipbuilding & Dry Dock Co., Chester, Pa.; C. I. MacGuffie, Mgr., Electric Welding Div., General Electric Co., Schenectady, N. Y.; J. B. Tinnon, Vice-Pres., Metal & Thermit Corp., 120 Broadway, New York, N. Y.

District Vice-Presidents: No. 1 (New York and New England), George M. Trefts III, Vice-Pres., Farrar & Trefts, Inc., 20 Milburn St., Buffalo, N. Y.; No. 3 (Southern), R. E. Lorentz, Jr., Metallurgist, Combustion Engineering Co. Inc., Chattanooga, Tenn.; No. 5 (Mid-Western), J. R. Wirt, Welding Engr., Delco Remy Div., G. M. C., Anderson, Ind.; No. 7 (Western), G. S. Schaller, Prof. Mechanical Engineering, University of Washington, Seattle, Wash.

BACK COPIES WELDING JOURNAL

The AMERICAN WELDING SOCIETY office has received a request for copies of the January 1939, January 1941 and February 1941 issues of THE WELDING JOURNAL. Any members who have copies of any or all of these issues and have no further need for them are asked to send them to the Society office at 29 West 39th Street, New York 18. The Society will pay 50¢ a copy.

SPECIFICATIONS FOR STAINLESS STEEL WELDING ELECTRODES

With issuance of the *Tentative Specifications for Corrosion-Resisting Chromium and Chromium-Nickel Steel Welding Electrodes* (A.W.S. Designation: A 5.4–46 T; A.S.-T.M. Designation A 298–46 T) the A.W.S.-A.S.T.M. Committee on Filler Metal has completed one more step in a program which is intended ultimately to provide a complete set of specifications for all types of filler metal used in welding ferrous and nonferrous metals by the various welding processes.

The new specifications, patterned after the Tentative Specifications for Iron and Steel Arc-Welding Electrodes for mild and low-alloy steel electrodes, provides classification and test requirements for twenty-four classifications of electrodes.

The classifications are grouped in six series covering the stainless steel types commonly identified as 19-9 (or 18-8), 25-20, 18-12 Mo (or 18-8 Mo), 19-9 Cb (or 18-8 Cb), 16 Cr and 4 to 6 Cr Mo. Each series includes classifications for an all-position d.-c. electrode, and all-position a.-c.-d.-c. electrode, a d. -c. downhand electrode and an a.-c.-d.-c. downhand electrode.

To provide users of the Specifications with assistance in the selection of the proper electrode for a given application, there is included as an appendix the Guide to the A.W.S.-A.S.T.M. Classification of Corrosion-Resisting Chromium and Chromium-Nickel-Steel Welding Electrodes in which the particular properties and uses of each classification are discussed.

Copies of the Specifications in the form of a 13-page, 6 x 9 in. booklet may be obtained at 25 cents each from the AMERICAN WELDING SOCIETY, 33 W. 39th St., New York 18, N. Y., or from the American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa.

STANDARD SPECIFICATIONS FOR WELDED HIGHWAY AND RAILWAY BRIDGES

(Published by the American Welding Society)

The fourth edition (1947) of the *Standard Specifications for Welded Highway and Railway Bridges* has just been published to replace the third edition issued in 1941.

The new edition should be of special interest because of the introduction of a new concept in design formulas. These are prescribed for both base material and welded connections according to the expected number of repetitions of loading which would produce maximum stress in a member. Such formulas are prescribed for two million, 600,000 and 100,000 repetitions with provision for modification where some other frequency of loading can be predicted. For structural members essentially subject to static stresses, normal unit stresses, similar to those prescribed for buildings in the *Standard Code for Arc and Gas Welding in Building Construction*, are specified. An extended discussion of these design formulas and their basis is discussed in one of the appendices. This should be of interest regardless of the joining method used.

The Specifications also include requirements for material, design details, workmanship and inspection. The section on material has been revised to provide more general use of A7 Steel, and the section on inspection has been expanded to include provisions for magnetic particle testing as well as X-ray and visual examination.

Copies may be obtained from the AMERICAN WELDING SOCIETY, 33 W. 39th St., New York 18, N. Y., at one dollar per copy.

BISHOP PROMOTED

Bent Laune, President, All-State Welding Alloys Co., 96 West Post Road, White Plains, N. Y., announced today that he has appointed Leicester B. Bishop of Cleveland, Ohio, to be the Ohio Regional Sales Manager for All-State's line of low-temperature welding and brazing alloys and fluxes. Mr. Bishop's territory includes all of Michigan except the upper peninsula, as well as the state of Ohio.

Mr. Bishop is a native of Tarrytown, N. Y. During the war he served in the Royal Canadian Air Force from December 1940 until September 1942, when he was transferred to the U. S. Army Air Force. Following his discharge from the army in 1945, he worked for International Latex Corp. before becoming associated with All-State. He is a member of the Cleveland Chapter of the AMERICAN WELDING SOCIETY.

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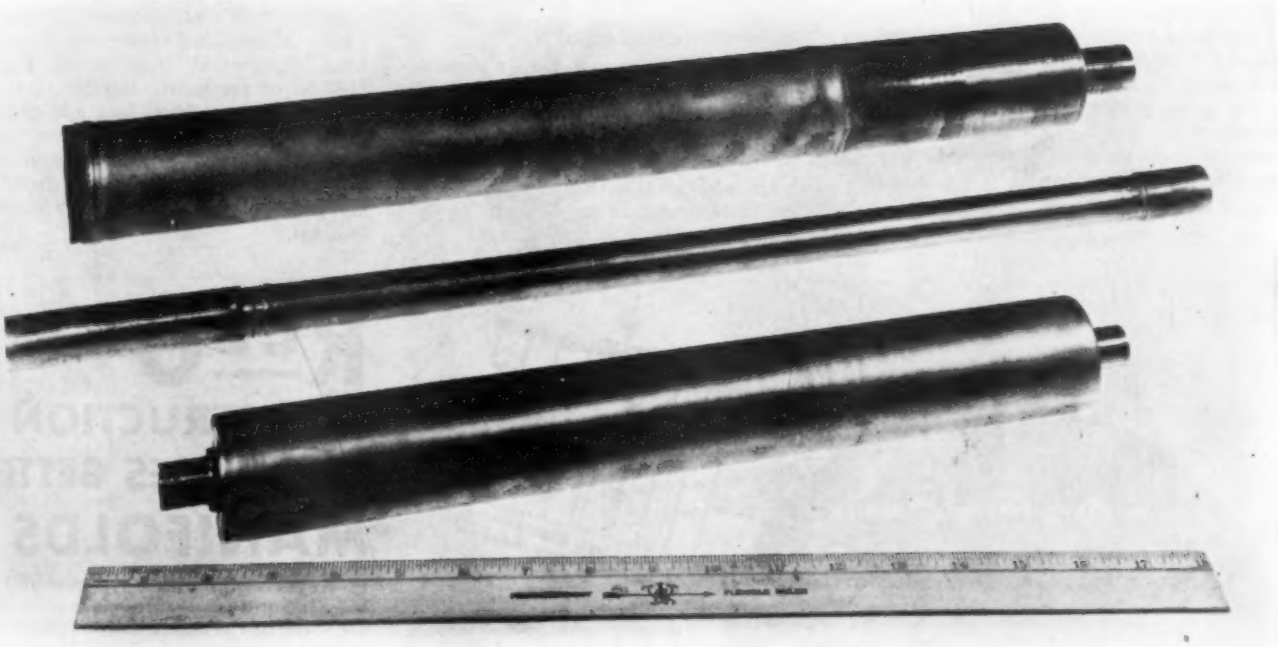

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NEW FRENCH MAGAZINE

A new magazine *Soudure et Techniques Connexes*, edited by the Society for Welding Publications at 39 Rue D'Amsterdam, Paris 8, France, has just been published. It replaces the following prewar magazines: *Revue de la Soudure Autogene; Bulletin de la Societe des Ingenieurs Soudeurs.*

The new magazine will publish in detail the papers read at the meetings of the Society of Welding Engineers. It will have a high technical content and will contain important information for welding industries and applications in France.

1946 BOOK OF A.S.T.M. STANDARDS, IN FIVE PARTS (OVER 1400 SPECIFICATIONS AND TESTS, ALMOST 7000 PAGES)

With more than 1400 standards, specifications, tests and definitions for a wide range of material, and containing almost 7000 pages, the 1946 Book of Standards has been issued in five parts instead of the former three volumes. This book carries the A.S.T.M. specifications and tests in their latest approved form.

The great growth in the number and volume of standards and tentatives compelled a division of the book into five separate parts as follows:

Part IA— Ferrous Metals.
Part IB— Non-Ferrous Metals.
Part II— Nonmetallic Materials—Constructional.
Part IIIA—Nonmetallic Materials—Coal and Coke, Petroleum Products, Aromatic Hydrocarbons, Soaps, Waters, Textiles, Gaseous Fuels.
Part IIIB—Nonmetallic Materials—Electrical Insulating Materials Plastics, Rubber, Paper, Shipping Containers, Adhesives.

Each Part of the 1946 Book has a complete subject index (from 36 to 44 pages). There are two extensive tables of contents, the first lists all standards under general materials headings; the second according to the serial designations of the standards. These features facilitate reference to any subjects covered.

Some idea of the large increase in the size of Books is indicated from comparative figures for the last four editions.

1939— 866 Standards—3700 Pages
1942—1104 Standards—4900 Pages
1944—1235 Standards—6030 Pages
1946—1400 Standards—7000 Pages

Supplements, Detailed Index

To keep the books up to date, a supplement will be issued to *each* part late in 1947. As a service with the 1946 Book of Standards there is a complete 240 page Index to Standards, which is furnished without additional charge. (The 1946 Index is in course of publication, to be available about June 20.)

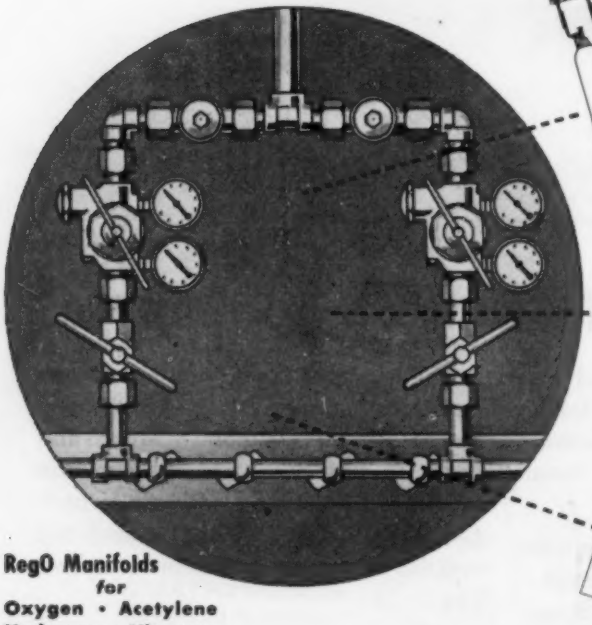
Sales Prices
1946 Book of A.S.T.M. Standards

Parts IA, IB, IIIA or IIIB	$ 8.00 each
Part II	$12.00
A complete set of all five parts	$44.00
1946 Book of Methods of Chemical Analysis of Metals	$ 4.50

Cloth binding. For Half Leather, add $2 to the above prices for *each* part. Copies may be obtained from the American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa.

STAINLESS-CLAD STEELS

Lukens Steel Co.'s Bulletin 338 describes the new Lukens' clad steel line, Lukens' Stainless-Clad Steels, and gives applications for the most important types of stainless cladding. Lukens Steel Co. has been manufacturing clad steels for over 17 years commencing with Nickel-Clad Steel in 1930, followed by Inconel-Clad, Monel-Clad and now Stainless-Clad. Important steps in the Lukens' method of producing stainless-clad steel are illustrated to show how uniformity of cladding thickness is maintained and a permanent bond insured. Several pages of corrosion data, size and weight tables, and photographs complete this interesting bulletin.



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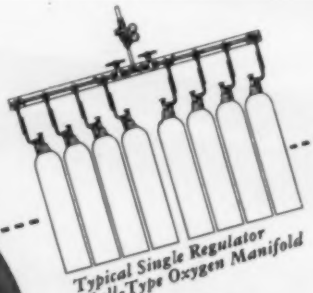

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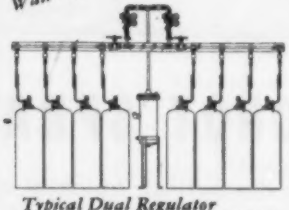
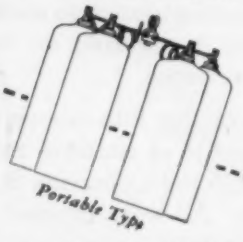


Typical Dual Regulator Floor-Type Acetylene Manifold



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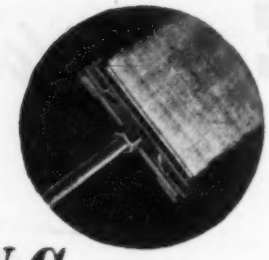

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the way for the "Big Blow"

A typhoon is just a puff compared with the wind that whips through this test tube for model airplanes at Cornell Aeronautical Laboratory, Buffalo, N. Y. The "big blow" is created by two 22-foot diameter fans that can generate a wind of over 700 miles per hour.

The inside walls must be smooth, scale free, since this gargantuan blast would shear off any little specks and drive them through a valuable test model plane with devastating force. To prevent this, every little bit of scale was removed from the thousands of square feet of metal surface before painting by Linde's flame-priming process.

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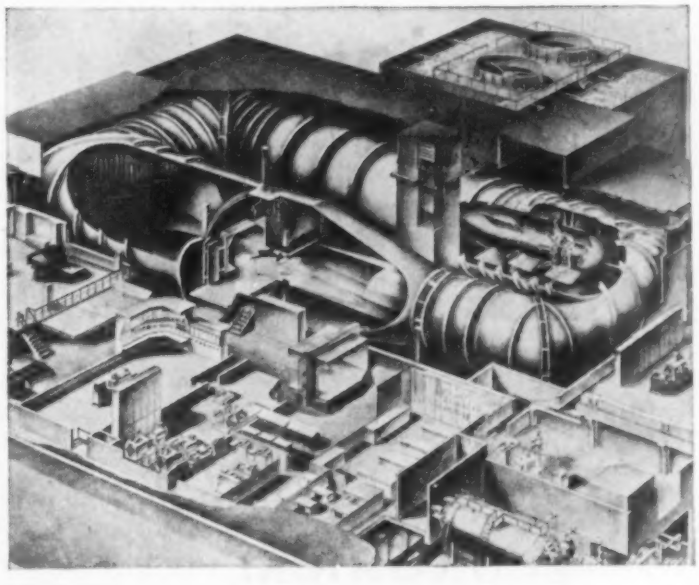
Linde service engineers are always available to help with problems of treating, cutting, joining, and forming metals. Linde research is constantly at work on the development of new and better methods for the production and fabrication of metals.



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NEW BOOKLET DESCRIBES PACKAGED RESISTANCE WELDING CONTROL

Synchro-Trol, a new line of synchronous-precision, a.-c. resistance welding controls in a complete, unified, factory-assembled package, is described in a booklet announced by the Westinghouse Electric Corp.

Designers or manufacturers of resistance welded products select the units they need from eight basic subunits listed in the booklet: The electronic contactor, heat control and firing panel, weld timer, electronic seam weld timer, electro-mechanical seam weld timer, pulsation weld timer, and N.E.M.A. 7B and 9B sequence weld timer. Five supplementary subunits available are the voltage regulator, current regulator, forge delay timing panel, tempering-sequency panel and blank panels for mounting small control items or permitting substitute installations. Charts show how these subunits are assembled to form various standard assemblies.

The 18-page illustrated booklet also describes the company's complete line of nonsynchronous controls, known as Weld-O-Timer, that makes available any desired combination for sequencing and timing from only four factory wired subassemblies and two supplementary subassemblies.

Copies of the new booklet (B-3839) may be secured from Westinghouse Electric Corp., P. O. Box 868, Pittsburgh 30, Pa.

WELDING SYMBOLS

By Vincent C. Gourley

Standards and symbols explained in this book are the ones recognized by the AMERICAN WELDING SOCIETY through whose efforts they have been simplified and reduced to the least possible number.

The general standards for the use of arc- and gas-welding symbols as well as resistance-welding symbols are explained in a unique and easy-to-understand way. The language is clear and simple and all points are illustrated.

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Price $2.50. Published by The Bruce Publishing Co., 540 N. Milwaukee St., Milwaukee 1, Wis.

OBITUARY

Carl F. Keel

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Use National Carbide in the Red Drum
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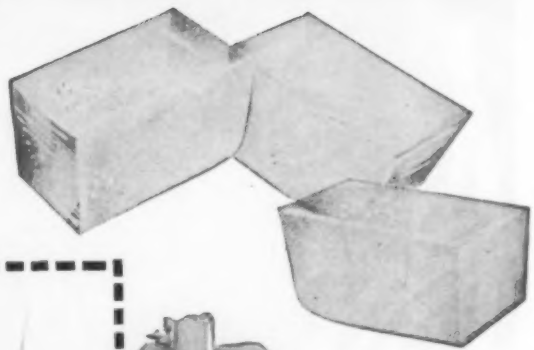
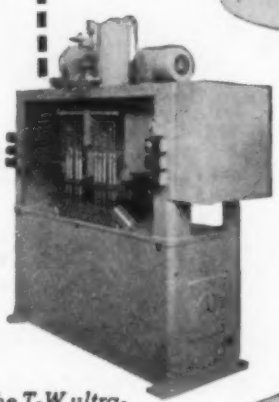
HOT PRODUCTION ON A -COLD ITEM-

★12 assemblies Every minute

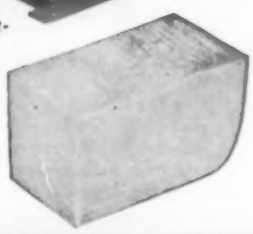
(16 PIECES PER ASSEMBLY)



(Upper left) the welded, aluminum, flexible ice cube separator and the backbone strip before welding. Notice the 18 projections.



(Right) the T-W ultra-hydrospeed welder.



★ON A T-W HYDRO-ULTRASPEED WELDER

A jig holds the 16 aluminum parts (backbone, 7 fins and 8 inter-locking sections), and indexes into the T-W ultra-hydrospeed welder (illustrated). The 18 projections are automatically welded.

Four operators, working in pairs, produce 12 uniform assemblies per minute, every minute, hour after hour, with essentially no rejects.

Servel made use of T-W's Engineering Service and both collaborated to produce this superior design of welder for Servel's refrigerator tray ice cube separator.

Resistance welding, properly applied, can bring you new production returns, too. T-W representatives can assist you in adapting spot, projection, seam, or flash-butt welding to your products.

THE TAYLOR-WINFIELD CORPORATION
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RESISTANCE WELDERS

NEW BOOKLET DESCRIBES PACKAGED RESISTANCE WELDING CONTROL

Synchro-Trol, a new line of synchronous-precision, a.-c. resistance welding controls in a complete, unified, factory-assembled package, is described in a booklet announced by the Westinghouse Electric Corp.

Designers or manufacturers of resistance welded products select the units they need from eight basic subunits listed in the booklet: The electronic contactor, heat control and firing panel, weld timer, electronic seam weld timer, electro-mechanical seam weld timer, pulsation weld timer, and N.E.M.A. 7B and 9B sequence weld timer. Five supplementary subunits available are the voltage regulator, current regulator, forge delay timing panel, tempering-sequency panel and blank panels for mounting small control items or permitting substitute installations. Charts show how these subunits are assembled to form various standard assemblies.

The 18-page illustrated booklet also describes the company's complete line of nonsynchronous controls, known as Weld-O-Timer, that makes available any desired combination for sequencing and timing from only four factory wired subassemblies and two supplementary subassemblies.

Copies of the new booklet (B-3839) may be secured from Westinghouse Electric Corp., P. O. Box 868, Pittsburgh 30, Pa.

WELDING SYMBOLS

By Vincent C. Gourley

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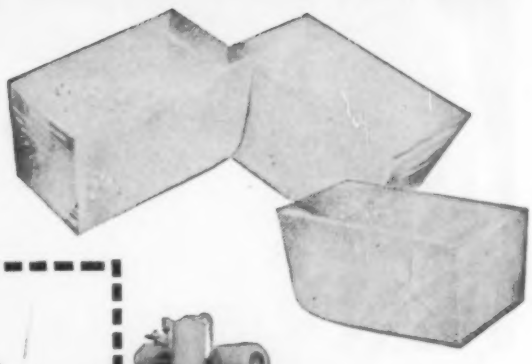

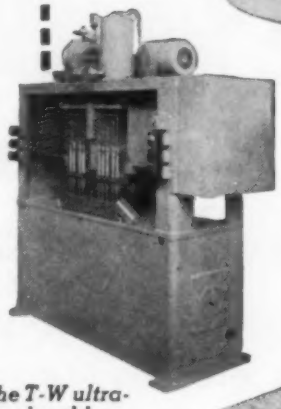

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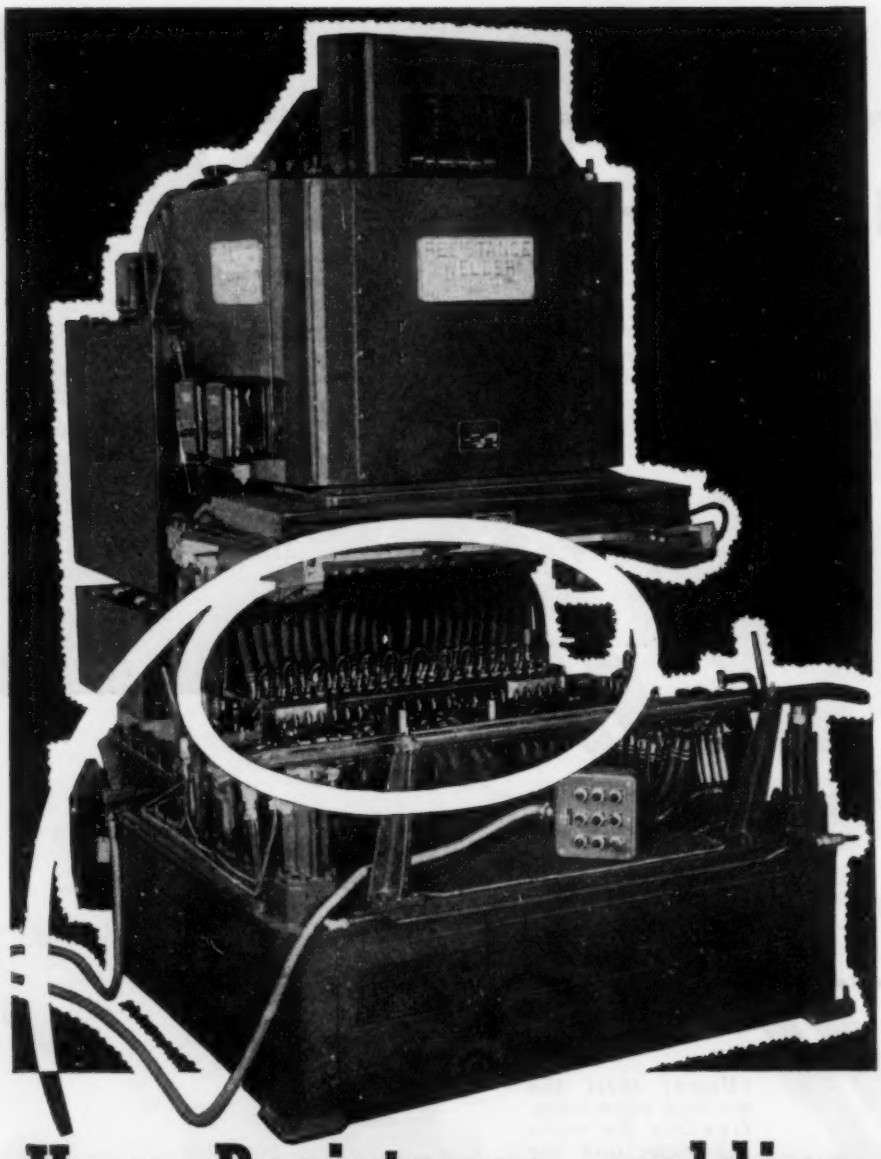


Here, Resistance-welding Costs "Get the Business"

The toughness of Ampco-weld resistance-welding electrodes reduces down-time, increases production, saves money . . .

The machine shown above—and 5 more just like it — must produce 1404 spot welds per minute. They are used by a leading automobile manufacturer to turn out 18 complete underpan assemblies per minute—each pan requiring 78 spotwelds.

Rigorous production schedules such as this, call for trouble-free operation. Ampco-weld resistance welding electrodes are ideal for this kind of service. They combine the hardness and toughness necessary to resist mushrooming and wear, with a high electrical conductivity that resists sticking to the work. Because of these features, Ampcoloy electrodes require less dressing — down-time is greatly reduced; production is increased.

The Ampco line of resistance welding electrodes and alloys is complete. It includes standard and special holders; all products meet R.W. M. A. specifications. Furthermore, Ampco is glad to furnish engineering service for specialized applications. Consult your nearest Ampco field engineer and write for latest bulletins.

Ampco Metal, Inc.

Department WJ-6 • Milwaukee 4, Wis.

AMPCO

RW-6

A.S.T.M. ANNUAL MEETING IN ATLANTIC CITY, JUNE 16-20

In addition to the 20 formal technical sessions which are part of the technical program for the Fiftieth (1947) Annual Meeting of the American Society for Testing Materials in Atlantic City, June 16–20 inclusive, there will be more than 250 meetings of the Society's technical committees. All sessions will be held at Chalfonte-Haddon Hall. There will be events under way morning, afternoon and evening of each of the days except the last day, Friday, June 20, when the closing sessions are scheduled for the afternoon.

This will be the Society's Fiftieth Annual Meeting, the first meeting having been held in 1898 in Philadelphia under the auspices of the American Section of the International Association for Testing Materials. The first Annual Meeting held during the year of the Society's incorporation in 1902 was at Atlantic City and since that time 30 of the annual meetings have taken place in Atlantic City.

More than 150 technical papers and reports by the country's leading authorities in the field of materials are scheduled, many of them being presented in connection with symposiums. On Monday evening, June 16, a Symposium on Load Tests on Bearing Capacity of Soils will be held. On Tuesday morning June 17, there will be a Symposium on Methods of Determining Air Entrainment in Concrete and in the afternoon a Symposium on Insulating Oil will be held. On Wednesday afternoon, the eighteenth, there will be the Symposium on Synthetic Lubricants, and at 4:30 the Edgar Marburg Lecture will be presented by Prof. W. C. Voss of Massachusetts Institute of Technology on "Engineering Laminates."

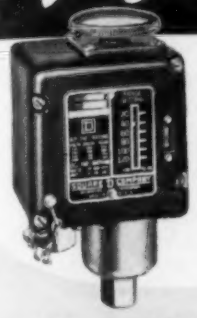
Another symposium to be held Thursday morning, June 19, will cover Rubber Testing, and there will be a Round Table Discussion on Water Formed Deposits on Thursday evening, and one on Speed of Testing on Wednesday afternoon.

Several other sessions of the meeting will cover Plastic Deformation of Metals (Thursday morning), Fatigue of Metals (Friday morning), Plastics and Wood (Friday afternoon), Electrodeposited Coatings and Metal Polishes (Wednesday morning), Soils (Tuesday afternoon), Cement and Concrete (Tuesday evening) and Steel (Thursday afternoon).

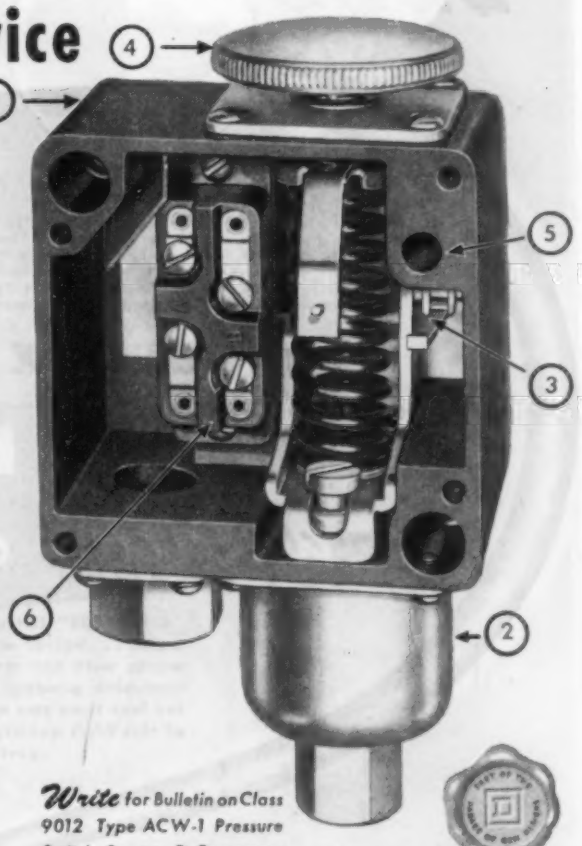
Apart from the Symposium on Monday evening, the day will be devoted to meetings of the various committees of the Society, and there will be three sessions during the week confined to reports of the technical committees so that much of the Society's business can be concentrated in sessions designed for that purpose.

The Annual Address of the retiring President, Arthur W. Carpenter, is to be given at an Annual Meeting Dinner on Wednesday night, June 18, arrangements to be sponsored by the Philadelphia District Council. Mr. Carpenter plans to discuss the progress made by A.S.T.M. marked by its Fiftieth Meeting, especially stressing the future outlook and indicating the important relations of research, not only in A.S.T.M. planning but in all industry concerned with materials.

New Pressure Switch *Designed* for Welder Service



These construction features make it a *better* pressure switch for resistance welder and other machinery applications:



1 *ENCLOSURE:* Gasketed, die cast construction is oil, coolant and moisture tight. Recessed mounting holes, sealed-off by cover gasket, provide an attractive appearance unmarred by projecting mounting lugs. Cover is chained to box and has self-retaining screws. Conduit hub is detachable for ease in installation.

2 *MECHANISM:* Bellows type actuator is of heavy wall construction. Hardened parts and short travel insure unusually long mechanical life under severe service conditions.

3 *INDICATOR:* Lever motion permits easy observation of switch action through window in cover to assist in proper setting and in detecting "flutter" or other faulty operation.

4 *RANGE:* Settings, externally adjusted from 20 to 120 p.s.i. by shaft with screw driver slot or accessory metal knob, are directly indicated by pointer reading on calibrated scale attached to enclosure cover. Lower and higher ranges are available for other machinery applications.

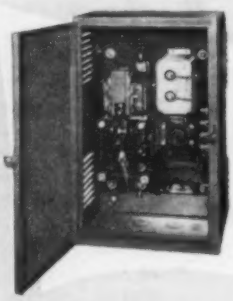
5 *DIFFERENTIAL:* Setting of 7 p.s.i., fixed for welder applications, can be adjusted by addition of set screw and compression spring readily accessible with cover removed.

6 *CONTACTS:* Heavy duty snap action switch mechanism of self-contained type has separated normally open and normally closed circuits permitting either normal or reverse action by choice of connection. Contacts are double-break, silver. Binder head terminal screws, located immediately adjacent to conduit entrance, accommodate 14 gauge wire. Melamine case is non-carbon tracking. Entire unit is readily removed for inspection or replacement.

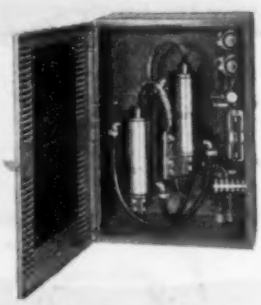
Write *for Bulletin on Class 9012 Type ACW-1 Pressure Switch.* Square D Company, 4041 N. Richards Street, Milwaukee 12, Wis.

ADDS TO BROAD LINE

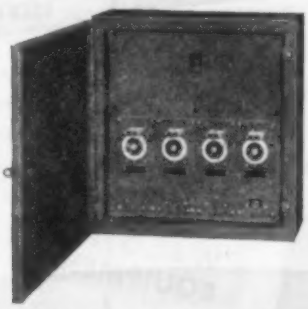
The new Class 9012 Pressure Switch becomes an important part of Square D's complete line of resistance welder control. Select from these popular items—



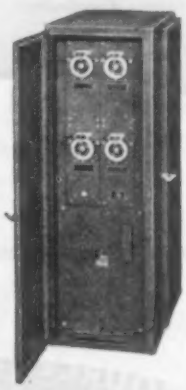
Syncro-Break contactors for welding applications involving changing loads, timing periods and duty cycles as well as frequent operation. (Bulletin 8990)



Electronic contactors, ideal for short welding times at heavy currents, exceptionally high-speed operation or jobs needing heat control. (Bulletin 8990)



Safront timers provide accurate, trouble-free control of each interval in the welding cycle, using individual pneumatic timing relays. (Bulletin 8991)



Combination controllers include contactor and timer in single enclosure for operator convenience, appearance and installation economy. (Bulletin 8992)

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4 FEATURE

TIME SAVING ★ LABOR SAVING

ALL THE WAY DOWN THE LINE

1 Thousands of twisted wires properly shaped provide extra-flexibility. Less tiring to handle.

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3 Bright copper wires of hair width sizes provide high conductivity. Steadier power on the job.

4 Heavy live rubber jacket and tape wrapping protect wires. Prevents "shorts" and breakdowns.

BURDOX

EXTRA-FLEX welding cable

"4 FEATURE" Extra-Flex Cable gives you more welds . . . better welds per man-hour because it works *with* the man-on-the-job. With its many exclusive production advantages, it costs you far less than you would expect to pay for cable of this high quality. Next time you order cable specify "Extra-Flex"!

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WELDING EQUIPMENT

CUTTING EQUIPMENT

PROTECTIVE EQUIPMENT

A cordial invitation is extended to all engineers and technical people concerned with the industrial fields in which A.S.T.M. is active, to attend the Annual Meeting.

INTERNATIONAL NICKEL EXTENDS FELLOWSHIP AWARDS

An extension of the Inco fellowship awards in Canada, Great Britain and the United States was announced by Robert C. Stanley, Chairman and President of The International Nickel Co. of Canada, Ltd., in his address before shareholders at the Annual Meeting in Toronto.

The fellowships are part of a broadened program of cooperation recently extended by International Nickel to universities and colleges in the field of technical education.

In announcing the fellowships for post-graduate study, Mr. Stanley said: "For the past six years post-graduate scholarships have been given by this company to students in three Canadian universities: Queen's, Toronto and McGill. A further program of cooperation has now been established with educational institutions in Canada, Great Britain and the United States which offer courses in mining, metallurgy and engineering.

"The objects are to assist in the better training of scientists; to extend their knowledge of nickel, copper, platinum and the platinum metals; and to encourage applications of the results of research to metallurgical industries."

In Canada, three scholarships are awarded annually by a committee of which R. L. Beattie, Vice-President in Charge of Canadian Operations, is chairman. Exhibits and technical literature will be given to libraries, faculties and students in twenty educational institutions. As rapidly as possible, technical literature and other material will be offered to all engineering schools in the Dominion. The distribution of technical papers will be under the direction of the company's Development and Research Division.

For Great Britain a fund has been established for resident and traveling fellowships over a period of years. The fund will be administered by a committee representing five British technical societies—The Iron and Steel Institute, The Institute of Metals, The Institution of Mining and Metallurgy, The Institute of British Foundrymen and The Institution of Metallurgists, as well as the company's British affiliate, The Mond Nickel Co., Ltd.

In the United States 6 two-year fellowships will be awarded biannually over a period of twelve years. Awards will be made by a committee of which Dr. Paul D. Merica, Vice-President of the company in New York, is chairman. Mr. Stanley added: "During the same period exhibits and technical publicity will be distributed to the libraries, to 1200 teachers and to 25,000 students in more than 50 educational institutions. As in Canada, this work will be under the direction of our Development and Research Division.

As Helpful to the Welder as his Torch!

NOVIWELD DIDYMIUM LENSES

Speed Work, Spare Eyes from Sodium Glare

These lenses are winners with welders because they do three protective jobs in one while the work moves faster and more accurately. In addition to eliminating hazards from ultra-violet and infra-red rays, sodium flare is screened. Thus the welder can control the formation of the bead more carefully and do a better job as Noviweld-Didymium does not impair the red and orange color values. Thereby, the cost and volume of secondary operations such as chipping, grinding and wire brushing are reduced appreciably and overall efficiency is increased.

Noviweld-Didymium lenses in shades 3, 4, 5 and 6 are available for immediate delivery. Your nearest AO Safety Representative can supply you.

American Optical COMPANY — *Safety Division*

SOUTHBRIDGE, MASSACHUSETTS • BRANCHES IN PRINCIPAL CITIES

As rapidly as possible the program will be offered to all engineering schools."

The fellowships provide an annual stipend and tuition for study in the fields of nickel, copper and the platinum metals. They will be awarded to the Massachusetts Institute of Technology, Carnegie Institute of Technology, Yale University, University of Michigan, University of Illinois and Johns Hopkins University.

BATTERY OPERATED MACHINES SPEED MULTI-SPOT FENDER WELDING

Multi-spot welding, increasingly popular for the assembly of sheet metal parts, due to the increased productivity per machine hour, has taken another step forward with the introduction of battery-powered machines for this type of work.

Advantages of battery-operated multi-spot welders are decreased line load and ability to perform a greater number of welds simultaneously. These advantages interlock to some extent since simultaneous welding of individual spots would impose high loads on electric power lines in the plant.

An example of the application of battery machines to mass production is in welding dust shields assemblies in the plant of one of the "big three." The parts to be assemblied with 11 spot welds are shown in Fig. 1.

The double station machine—designed and produced by Progressive Welder Co., Detroit, for handling both right and left hand dust shield assemblies—is shown in Fig. 2. Batteries (16 cells, 8 volt) are contained in a housing in the rear center of the machine. At the left are a group of package-type chargers, above which is the charger control. Machine controls (timers are shown in the center (top) of the machine). A total of only 30 kva.—balanced on three phases—is required to keep batteries charged.

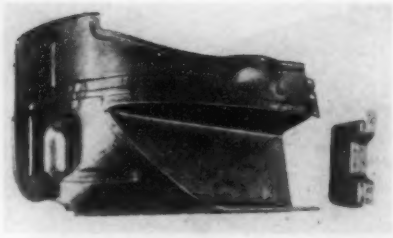

Fig. 1—Dust Shields Are Assembled 140% Faster in One Plant Through Use of Battery Powered Welding Machines

Only Two "Shots"

In operation, only two "shots" from the batteries are required to complete all eleven welds. The first "shot" produces six welds simultaneously, while the second produces the other five welds. Production is 300 assemblies per hour, with two men to load and unload. With the previous setup, the two men could produce only about 125 dust shield assemblies per hour. The ease of loading the machine reduces the amount of operator effort required despite the increased productivity. Material is 20 gage cold rolled steel. Parts are dropped into the fixture and the "start" button is pressed. All electrodes come down on the work, the electrodes acting as clamps. On completing the cycle, electrodes retract to permit removal of the assembly.

First Use of Stored Energy for Multi-Spot Welding

This machine incidentally represents the first use of stored energy machines for commercial multi-spot welding. Condenser or magnetic energy machines are not practical for this type of work since, if welds are to be made consecutively, too much time is lost in recharging condensors, etc. If welds were to be made simultaneously, capacity demand would be too high.

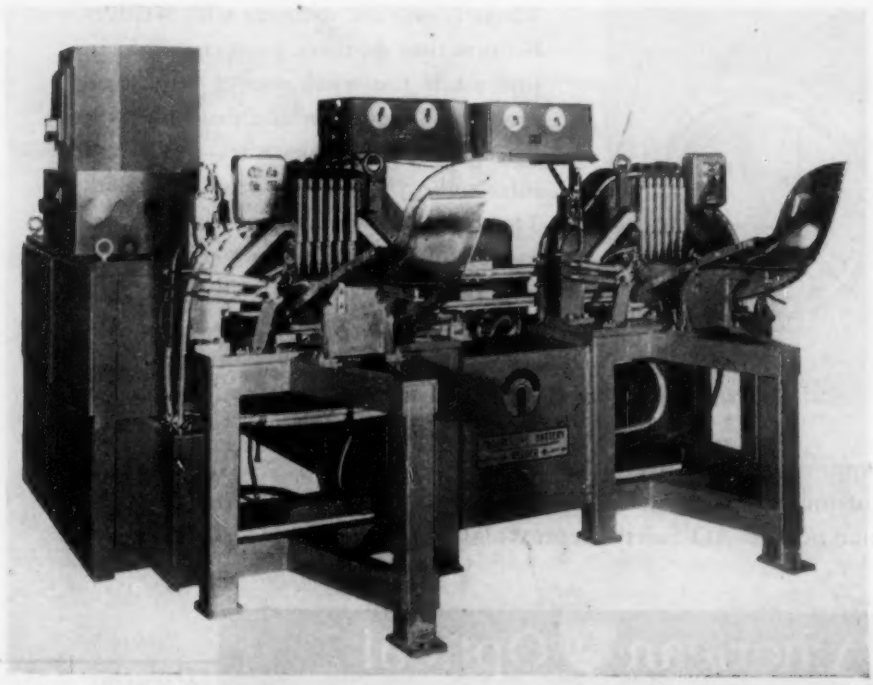

Fig. 2—300 Dust Shield Assemblies Are Produced on This Progressive Welder Machine. Machine Handles Both LH and RH Assemblies; Makes 11 Welds with Just Two Shots

McKAY CO. MIDWESTERN MANAGER

The promotion of George Hohmann as Chicago District Manager of the Electrode Division, with headquarters in Chicago, has been announced by The McKay Co., leading producers of shielded arc welding electrodes.

Mr. Hohmann's broad experience in the welding industry, together with his intimate knowledge of the needs of the midwestern industrial markets, admirably qualifies him for this post. He joined The McKay Co. in 1942 to help set up additional electrode manufacturing facilities at The McKay Co.'s McKees Rocks plant.

During the war, in addition to his other duties, Mr. Hohmann was instructor of Welding Theory at the William Penn High School at York, Pa., in the government-sponsored vocational programs, and he traveled about the country in an advisory capacity for the various war plants which weld-fabricated armament and equipment.

Mr. Hohmann is a member of the AMERICAN WELDING SOCIETY. He studied Chemical Engineering at Centenary College, Shreveport, La.

NEW APPOINTMENTS AT EUTECTIC

Mr. Rene D. Wasserman, President of the Eutectic Welding Alloys Corp., pioneers and originators of "Low Temperature" Welding Alloys, has announced the appointment of Albert E. Zeisel to the position of Vice-President in Charge of Sales.

A product of
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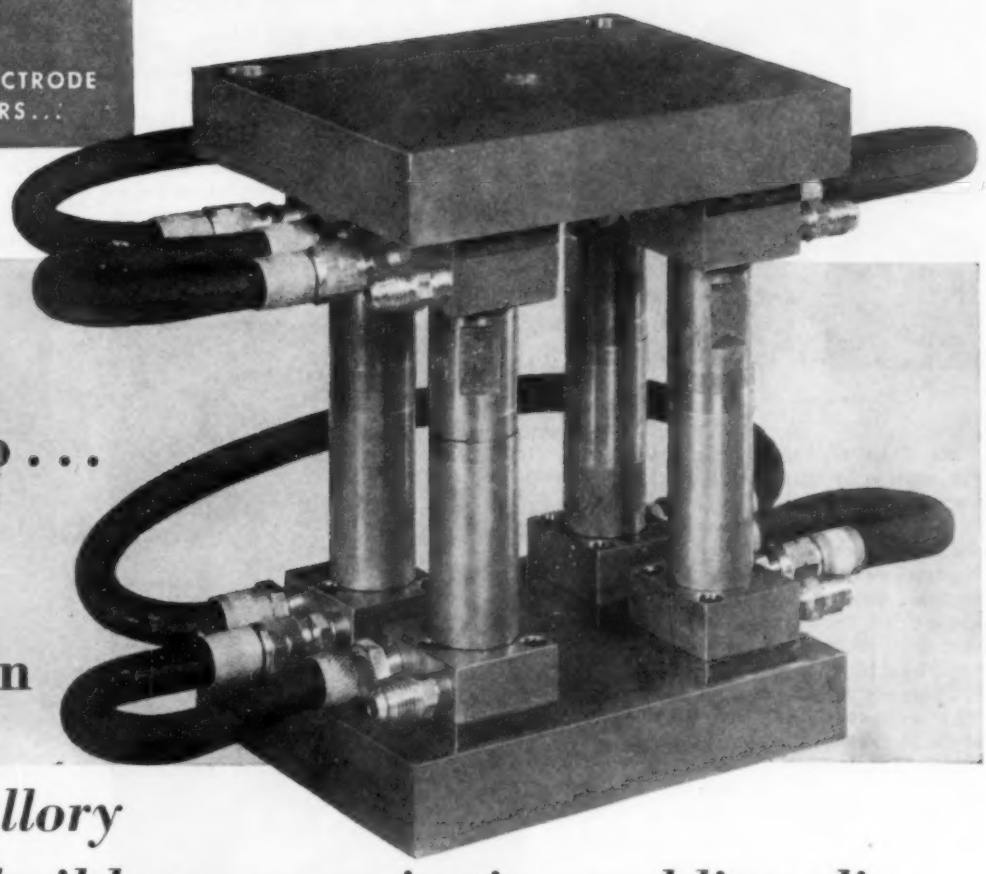
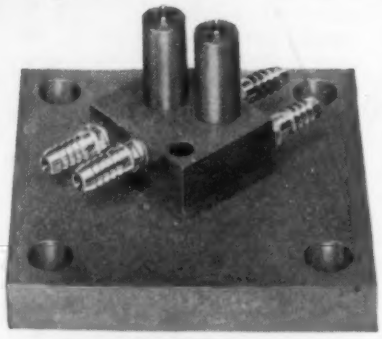
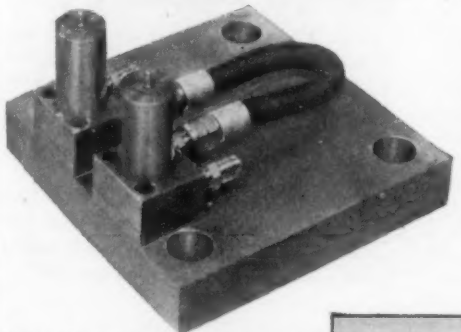
WELDING ELECTRODE
HEADQUARTERS...



They do a better job... and they cost less in the long run

... when Mallory designs and builds your projection welding dies





When Mallory builds a special die for you, we make it with standard parts wherever possible—parts such as the standard stock, Elkonite*-faced electrodes shown in the dies pictured. This means delivery in the shortest possible time, easy and quick replacements—with a saving of money, too, by eliminating expensive specials.

What's more, the die is designed for your specific requirement using the best possible alloys to do the job—alloys developed by Mallory's long metallurgical experience—alloys that withstand thousands of welds before redressing is necessary. And the finished product has other convenient "plus" features, such as the insulated steel locating pins in the dies on the left, holding of close tolerances, adequate and proper water cooling . . . all backed by Mallory's years of experience.

Economy, efficiency, expediency—that's what Mallory offers in building projection welding dies. Our skill and know-how are available to solve your problems.

*Reg. U. S. Pat. Off.

In the United Kingdom, made and sold by MALLORY METALLURGICAL PRODUCTS, LTD. (An Associate Company of Johnson, Matthey & Company, Limited), Hatton Garden, London, E. C. 1.

RWMA

P. R. MALLORY & CO. Inc.

MALLORY STANDARD RESISTANCE WELDING ELECTRODES

P. R. MALLORY & CO., Inc., INDIANAPOLIS 6, INDIANA

Mr. Zeisel became associated with the Corporation in 1944 as a Field Engineer for Virginia and the District of Washington. The following year he was appointed Regional Manager of the Mid-Western area, and on January 1, 1946, he became Assistant to the President in Charge of Sales, with his headquarters in the New York Office. Mr. Zeisel assumed his new position as Vice-President in Charge of Sales on the first day of 1947. He is a member of the New York Section of the AMERICAN WELDING SOCIETY and the St. Louis, Missouri Chapter of the American Society of Metals. During World War II he was an Associate Welding Engineer of the New York Navy Yard.

METALLIZING NEWS

Corrosion resistance through metallizing is the dominant theme of the April 1947, issue of *Metco News*, published quarterly by Metallizing Engineering Co., Inc., Long Island City. A fleet of steel tuna fishing clippers is metallized for protection of hull and decks; cargo tanks of all-steel shrimp trawlers effectively resists shrimp acid corrosion; a large manufacturer of food freezers uses metallizing for rust prevention. Also described is the metal spraying of casein glued pressed paper tubes for "Sono Boys" with which the Navy tracked down submarines; the spraying of a metal band on to porcelain insulators to prepare for soldering on a flange; the resurfacing of a giant freeze roll with a ton of stainless steel in only four days; and the saving of money on maintenance and material by a coal company. An article from the Metco laboratory describes the selection of carbon steels for metallizing.

ISAAC HARTER ELECTED CHAIRMAN OF THE BOARD OF THE BABCOCK & WILCOX TUBE CO.

A. G. Pratt, President of The Babcock & Wilcox Co. and The Babcock & Wilcox Tube Co., announced that Isaac Harter has been elected Chairman of the Board of the Tube Co., Beaver Falls, Pa., and will henceforth give his undivided attention to its development. Accordingly, he retired from his position as Vice-President and Director of The Babcock & Wilcox Co. on April 1st.

"While Mr. Harter will give his attention in the future to the problems involved in the further development of the Tube Co.," said Mr. Pratt, "his knowledge of the steam generating industry and his wide experience will continue to be available to The Babcock & Wilcox Co. on matters pertaining to its business."

Mr. Harter joined The Babcock & Wilcox Co. in 1907. He was Superintendent of its Barberton (Ohio) Works, 1907-10; Superintendent of its Bayonne (N.J.) Works, 1910-20; and Assistant to the President, 1920-24. He has been a Vice-President and Director of The Babcock & Wilcox Co. since 1924, and has served as Executive Vice-President and Director of the Tube Co.

With the election of Mr. Harter to the chairmanship of the Tube Company Board, P.D. White becomes Executive Vice-President of the Company. Mr. Pratt is President and C. W. Middleton, Vice-President. Mr. Harter is a past Vice-President of the A.W.S. and of the Executive Committee of the Welding Research Council.

AIR REDUCTION APPOINTS HAMILTON SEATTLE DISTRICT MANAGER

L. A. Hamilton formerly assistant manager of Air Reduction's Seattle District has been appointed manager of that district according to a recent announcement by H. P. Etter, Pacific Coast Manager.

The Seattle District embraces practically the entire state of Washington, the northern part of Idaho and the state of Montana.

Mr. Hamilton, who graduated from Rice Institute with a B.A. degree in 1929 started with Air Reduction in 1930. After serving in the Houston and Los Angeles Districts Mr. Hamilton went on military furlough in 1941. He attended Officer Candidate School at Fort Sill, Okla. and later served as Commandant of Cadets of Brooks Field, Texas. He was discharged from the army in 1945 with the rank of captain.

In May of 1946 Mr. Hamilton was appointed assistant manager of the Seattle District; a position he held until his recent promotion.

NEW CHAMPION RIVET LITERATURE AVAILABLE

The Champion Rivet Co., Cleveland, Ohio wishes to announce that pamphlets are now available describing in detail two of their latest developments in Welding Electrodes. These Electrodes are known as: Champion High Speed Tool Steel Electrodes and Champion C-30.

The literature on High Speed Tool Steel Electrode describes and illustrates how to make your own composite roll turning tools, using ordinary Carbon steel for base

Let this be your guide...

in welding high NICKEL alloys to dissimilar metal . . . ferrous or non-ferrous

HOW TO JOIN DISSIMILAR METALS

Monel* to Steel
Metal Arc Weld with . . . . "130X" Monel Electrode
Oxy-Acetylene Weld with "40" Monel Gas Welding Wire and INCO "1" Flux

Nickel to Steel
Metal Arc Weld with . . . . "131" Nickel Electrode or
"130X" Monel Electrode

Inconel* to Steel
Metal Arc Weld with . . . . "132" Inconel Electrode or
"133" 80/20 Nickel-Chromium Electrode

Monel to 18/8 Stainless Steel
Metal Arc Weld with . . . . "130X" Monel Electrode or
"131" Nickel Electrode

Nickel to 18/8 Stainless Steel
Metal Arc Weld with . . . . "132" Inconel Electrode or
"133" 80/20 Nickel-Chromium Electrode

Inconel to 18/8 Stainless Steel
Metal Arc Weld with . . . . "132" Inconel Electrode or
"133" 80/20 Nickel-Chromium Electrode

Monel to Nickel
Metal Arc Weld with . . . . "130X" Monel or "131" Nickel Electrode
Oxy-Acetylene Weld with "40" Monel or "41" Nickel Gas Welding Wire and INCO "1" Flux

Monel to Inconel
Metal Arc Weld with . . . . "130X" Monel or "131" Nickel Electrode
Oxy-Acetylene Weld with "40" Monel or "41" Nickel Gas Welding Wire and INCO "2" Flux

Monel to Cast Iron
Metal Arc Weld with . . . . "Ni-Rod" Electrode

Nickel to Cast Iron
Metal Arc Weld with . . . . "Ni-Rod" or "131" Nickel Electrode

Nickel to Inconel
Metal Arc Weld with . . . . "131" Nickel or "132" Inconel Electrode
Oxy-Acetylene Weld with "42" Inconel Gas Welding Wire and INCO "2" Flux

*Reg. U. S. Pat. Off.

INCO
TRADE MARK

USE THIS HANDY TABLE

It's a useful guide to help you pick the right electrode or welding wire.

Calls often come through for welding Monel, nickel or Inconel to a different metal...particularly in lining work...and sometimes the demand is for a vessel lined with one metal in the top and a different one in the bottom.

You'll find the proper welding material for such jobs listed in the handy table. Many other welded construction call for INCO Nickel Alloys used in conjunction with different metals. For example, your customer may want stainless steel supporting members welded to a nickel still.

Keep the table handy... it simplifies choosing exactly the right electrode or welding wire for each job. But remember that the success of many dissimilar joints depends on the way they are made. If you want a complete outline of the welding procedures required on your particular job, just send the details of the joints you must make to INCO's Technical Service Division.

And for a detailed over-all picture of how to weld the INCO Nickel Alloys, write for Technical Bulletin T-2. It's yours for the asking.

THE INTERNATIONAL NICKEL COMPANY, INC.
67 WALL STREET NEW YORK 5, N. Y.

ADVERTISING

material, and welding on a cutting edge with Champion High Speed. This same method can be used to make planer, shaper and lathe cutting tools.

The Champion C-30 electrode literature describes the proper electrode to use for the building up of wearing surfaces on Shafts, Pins, Bushings, Axles, Guides, and all Locomotive and Industrial parts where long wearing machinable welds are necessary.

Champion C-30 Electrodes have good wearing qualities and are readily machinable. Write for free pamphlets.

HOBART TRADE SCHOOL INSTALLS NEW MACHINES

The Hobart Trade School has recently installed several new machines that keep it abreast of the latest developments in all branches of the field of welding instruction.

The new gas welding building, opened last January with a capacity of 60 students, has just had added to its equipment an oxyacetylene flame cutting machine. The machine made by the National Cylinder Gas Co. uses oxygen and acetylene to cut up to 6 in. of metal in thickness.

Another new machine in the gas building is the boiler plate roller built by the Webb Corp., Webb City, Mo. It is used to show the students how to make tanks

and smokestacks. It has an unloading device that operates by compressed air which takes off the end clamp quickly and saves a great deal of time and labor unloading the article rolled.

On the second floor of the main trade school building heat treating apparatus has been set up for instruction in this growing field of metal study as part of the tool welding course.

With Hobart Trade School graduates meeting more and more tool and die steels upon graduation, it was decided to give them complete training in welding tool and die steels, including their heat treatment.

The full tool and die course includes oil, water and air hardening. In addition to tempering tool steels the students learn carburizing with the vapo-carb unit just installed. It uses a fluid taken into a furnace with a red hot cylinder enclosed within. This converts the fluid to a vapor. Placing a tube of ordinary mild strength steel in the carburizing furnace impregnates the surface with carbon. Then it is quenched and can be used for many of the same purposes as expensive high carbon steel.

The Hobart Trade School now trains an average of 50 G.I.'s a month, 90% of the student body being former service men. The school was started in the Hobart Brothers factory in 1931 and the modernistic main building was built in 1940. The gas building was constructed last year though not occupied until January.

In addition to the new gas welding building, Hobart Brothers Co. just recently converted a large home, next to the gas building, into an attractive and comfortable dormitory to provide living quarters for its ever-increasing enrollment. As in any other city, living quarters are not plentiful in Troy, but due to the fact that the school has welding classes coming and going every week, rooms in attractive private homes or in the new dormitory are always available to Hobart Trade School students. In converting the home into a dormitory, the students comfort and conveniences were kept most in mind. A large living or recreation room provides comfortable quarters for study, reading, writing, card playing and good fellowship. The bedrooms are provided with double deck bunks so that more floor space is available and more students can be housed without crowding. The modern shower and toilet facilities are a most welcome place after a long, hard session in the school.

(*Continued on page 536*)

Buy "Proven Fluxes" with Years of Guaranteed Satisfaction behind them
The Trade-Name is "ANTI-BORAX"

Ask for Them *Unequalled for Quality*

A Flux for every metal: Cast Iron Welding Flux No. 1; Brazing Flux No. 2; Braz-Cast Flux No. 4 for bronze-welding cast iron; "ABC" Aluminum Flux No. 8 for sheet Aluminum and all alloys of Aluminum; Stainless Steel Flux No. 9; Silver Solder Brazing Flux No. 10; No. 16 Silver Solder Paste Flux.

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Fort Wayne, Indiana

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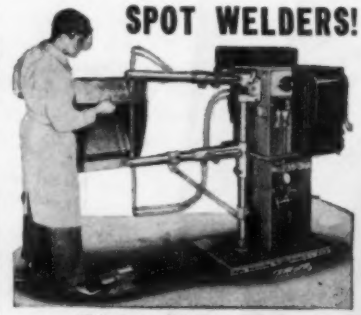
OF ALL TYPES
SIZES 1/4 TO 300 KVA.
FOR MANUAL, AIR, MOTOR, OR ELECTRONIC OPERATION.
also BUTT, ARC, and GUN WELDERS



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Triples Production With "Fleet-Welding" Technique

BY M. BOGIN, PRESIDENT
EAGLE SHEET METAL MANUFACTURING COMPANY
CHICAGO, ILL.

IN the arc-welded fabrication of cabinets for teletype printers, we have tripled our production by adopting Lincoln "Fleet-Welding" procedures. Fig. 1 shows three stages in the cabinet production—the component parts at left, the welded assembly in the middle, and the finished cabinet with welds ground off at right.

Formerly we used a 3/32" E6012 electrode with straight polarity for joining the 16-gauge mild steel pieces. Now we use 1/8" size "Fleetweld 5". The trick is to use this normally "reverse polarity" electrode with "straight polarity", in other words, with the electrode negative and the work positive. Also it is desirable to tilt the joint so as to weld slightly downhill. All welding is done in a fixture (shown in Fig. 2) which clamps the pieces into tight fit-up and allows positioning for welding downhill at an angle of about 30°. As a result, we weld three times as fast, the welds are stronger and pin holes are eliminated. Also, the flat bead of "Fleetweld 5" reduces grinding by one-half.

The parts are stamped and formed in die presses. The main welds are those joining front panel to sides (see Fig. 1), two joining the back top corners and two small flange inserts at back, bottom. All joints are butt with good fit-up and copper back-up. Welding is done from the outside only and penetrates 100%.

Fig. 1. Stages of cabinet production. Left: Component parts. Center: Welded assembly. Right: Finished cabinet.

In developing this procedure we had the assistance of the local Lincoln engineer. To obtain welding assistance, or a free copy of Bulletin 440 describing "Fleet-Welding" procedures for all thicknesses of mild steel and all types of joints, manufacturers should call the local Lincoln engineer or write THE LINCOLN ELECTRIC COMPANY, Dept. 126, Cleveland 1, Ohio.

Fig. 2. This fixture permits positioning for downhand welding throughout.

Fig. 3. Grinding the welds is now 100% faster due to flatter bead of "Fleetweld 5".

NOW It's Easier to WITH THESE

W-32 for formerly "hard-to-weld" steels

Copyright 1947 General Electric Company

Type W-32 is a lime-ferritic electrode especially developed for successful production welding of so-called "problem" steels—cold rolled, high-carbon, high-sulphur, and steels of high hardenability which are susceptible to underbead cracking. With stable arc characteristics providing good directional control, W-32 offers the following primary advantages:

1. **Elimination of underbead cracking on hardenable steels.**

2. **Material reduction in hydrogen content of the weld metal produces welds that can be *successfully enameled without heat treatment.***

3. **Marked decrease in tendency for surface holes to occur when base metal is high in sulphur content.**

4. **Excellent appearance of finished welds.**

5. **Spatter is minimized, deposition efficiency is high, penetration is adequate but not excessive, and slag is sufficiently heavy and fluid to provide good protection against oxidation; and the new, improved version of this electrode is suitable for welding in *all* positions with either reverse-polarity d-c or a-c.**

If you are welding any of these steels, you'll want to investigate W-32. Too, you may want to consider the use of special steels such as free machining or cold-rolled, which welding limitations have heretofore ruled out. W-32 has removed these limitations.

STAINLESS STEEL ELECTRODES

G.E. has just recently introduced an outstanding line of stainless steel electrodes—27 types in all, including both Lime and Titania type coatings—for better welding of all AISI standard analyses of stainless. For information on these, W-32, W-2075, or any G-E arc-welding electrodes, equipment, or accessories . . .
. . . CONSULT YOUR NEAREST G-E ARC-WELDING DISTRIBUTOR.
Apparatus Department, General Electric Company, Schenectady 5, N. Y.

HERE'S WHAT USERS SAY ABOUT

ELECTRODES

GENERAL ELECTRIC

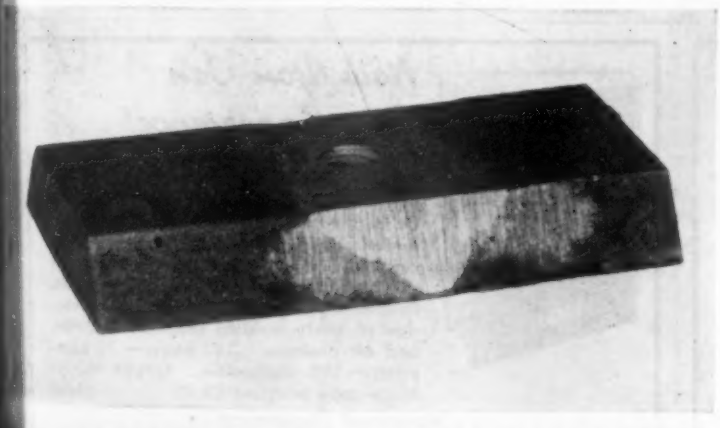
Weld "Problem Metals" NEW G-E ELECTRODES

W-2075 for making *machinable* welds on cast iron

This latest addition to the G-E electrode line has been developed specifically for making machinable welds on cast iron. It is equally suitable for both welded fabrication of cast iron and for repair work, and is extremely useful for filling holes and making repairs on castings.

Numerous applications are to be found in repairing motor blocks, radiators, machined parts, and other cast-iron sections requiring machining, drilling, or tapping; it is also recommended for welds where pre-heat cannot be used.

Weld deposits are smooth, uniform, and well bonded to the cast material; they are free from internal and surface porosity. The ability of the deposited metal to bond readily with the cast material, plus the absence of any large volume of slag, makes W-2075 usable in *all* positions with either a-c or d-c.



This cast block has been V'd out, welded with W-2075, and then drilled and threaded. Note the excellent bond between weld and parent metal and the absence of cracks and porosity.

➔ VERSATILE W-20 ELECTRODE REDUCES ROD STOCKS

"Our continued purchases of G-E W-20 electrode over a number of years have been made as a result of the tested adaptability and versatility of this general purpose rod. Through its use in various phases of road machinery fabrication, we have found it possible to cover a multitude of welding applications without the necessity of stocking a large variety of welding rods.

"In our production of large road building equipment there is need for an electrode which is particularly adaptable to poor fit-up work and can be used in all positions. We have found the W-20 electrode not only answers these requirements, but could be employed with either A-C or D-C machines, insuring the utilization of all available welding units on a single production line, if so desired.

"We sincerely appreciate your cooperation and many helpful welding recommendations—in particular, those in reference to the application of the versatile W-20 electrode."

Yours very truly,
W. A. RIDDELL CORPORATION
(Bucyrus, Ohio)
By:
Jacque Jones
General Manager

(*Continued from p. 532*)

The faculty of the Hobart Trade School has one advantage over teachers in other schools, in that it sees new faces every Monday as new classes are organized weekly. The complete course lasts 16 weeks.

Average classes are also much smaller than those of the average postwar school marm, being from 10 to 18 men. During the way, many women were enrolled but welding is pretty heavy work and there are now no women students at the school.

Robert Bercaw, supervisor, says opportunity beckons to many of his new grads as welding is still in its infancy. He thinks only a quarter of its potential uses have been developed to date by modern industry. He has been with Hobart Brothers 15 years.

Photo, courtesy of Austin Company, Engineers & Builders

NEW TYPE DRAFTING ROOM

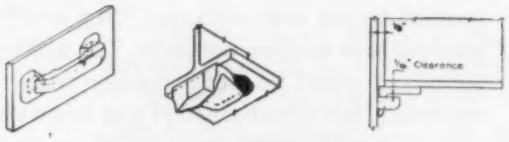
More than one hundred and fifty designing engineers in this recently enlarged Cleveland District drafting room, adjacent to the Austin Company's General Offices, have found that the room's new lighting and air-conditioning materially reduce the strain of their work.

Recessed, fluorescent troffer units on 3-ft. centers, extending the length of the room between the welded rigid frame arches, have each been equipped with one daylight and one soft-white tube of 40 watt intensity. With mounting heights which range from 13-ft. near the outsides of the 70-ft. span to 22-ft. at the peak, a uniform, well-balanced lighting intensity of over 90-ft. candles is maintained on the drafting tables. The troffer units have been suspended from the purlins, and the metal acoustic ceiling is supported by these lighting fixtures.

Three lines of air-conditioning supply ducts are located on each side of the room toward the outside of the span. These extend the length of the building, and are supported on the rigid frame arches, being located between the purlins. A space between the four lines of purlins in the high center section serves as a return air duct.

PROJECTION WELDING

An ingenious yet simple manufacturing process which not only increases the security of attachment of automobile or truck bodies and steering gear assemblies to chassis frames but also reduces manufacturing cost and chances of misalignment has been developed by Midland Steel Products Co.



WELDING CONNECTORS

Saxe System Welded Connection Units for welded assembly

Saxe Units place in position and securely hold together structural parts to be welded.

As used in many welded structures they *eliminate all hole punching*, producing an economical, rigid, safe and quickly erected structural frame.

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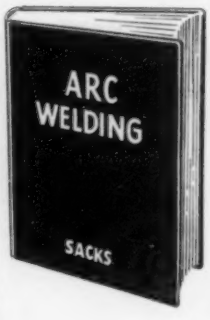

Now You Can Buy Experience!

This book is written by R. J. Sacks who is both a teacher and a practical welder (Member American Welding Society). It contains all the theory of welding — equipment, fundamental operations, testing, etc. — PLUS a complete training course for operators. 58 different jobs each with its own blueprint. Real on-the-job training with thorough coverage of every welding situation, condition, and all positions. 383 pages — 70 blueprints — 500 illustrations. ORDER NOW. Single copy postpaid $3.20.

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TRAVELING DEMONSTRATORS

Here is a lifetime opportunity for men (25 to 35 years) free to travel, to become affiliated with a well-known national organization to demonstrate and consult on electrodes and welding rods. Experience and thorough knowledge of all welding processes and brazing required. Good health and vision necessary. At least two years sales experience essential (any field). At least high school graduate, although special college courses desirable. Mail complete hand-written résumé, mentioning salary earned, to Box V-207.

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Black and White ***Effective Jan. 1, 1946***

Space	One Insertion	Three Insertions	Six Insertions	Twelve Insertions
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Quarter Page	50	48	45	40
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*Inside Preferred	170	155	145	135

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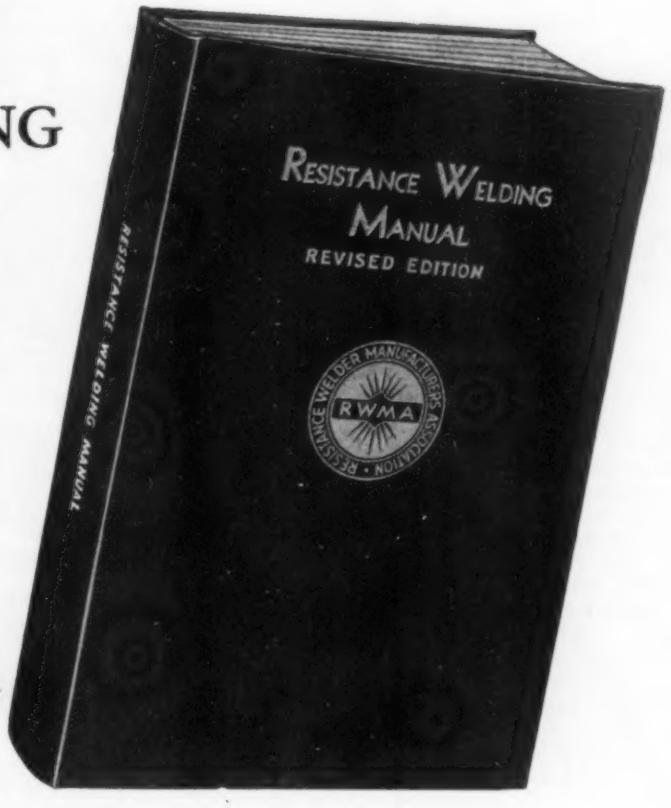

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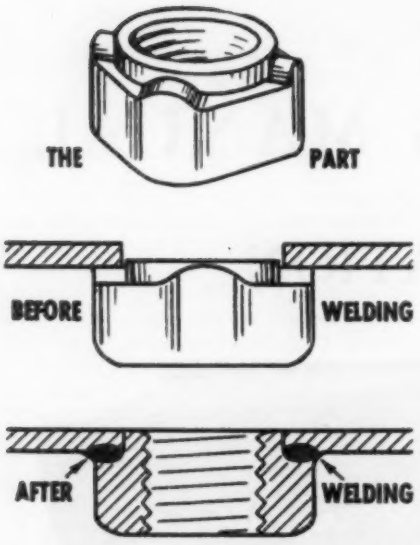


Figs. 1–3—Projection Welding Is Used by Midland Steel Products Co. to Attach Threaded Nuts to Automotive Frame Side Rails

The process consists of projection welding previously threaded nuts to frame side rails. The nuts, shown in the sketch (Fig. 1), have four projections formed on the attachment side of the head during the forging process. To attach a nut to the frame, it is placed, with projections "up", in the lower die of the platen of a 100 kva. Progressive Welder Co. press welder. The side rail is slid along, until a registering hole in the channel (see Fig. 4) drops over the shoulder on the nut. The upper platen is brought down, one shot of current is passed through the electrodes, fusing the projections to the side rail and the job is finished.

Advantages over the previous method of either arc welding or mechanically attaching such nuts, are greater security of attachment, accurate alignment, and considerable increase in output, particularly since nuts do not have to be tapped or re-tapped after welding.

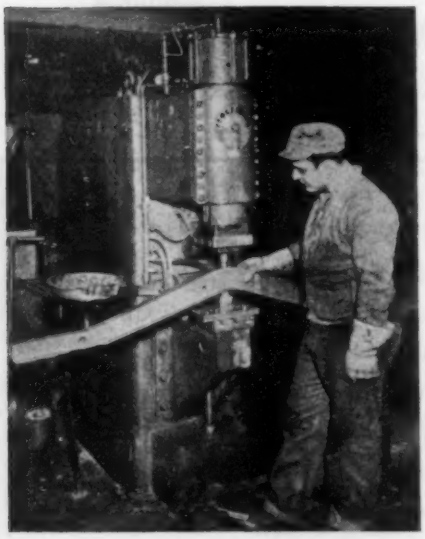


Fig. 4—Projection Welding a Threaded Nut to a Side Rail

Nuts attached to side-rails in this manner range from $^1/_4$ to $^1/_2$ in. nominal size, the same Progressive machine being used regardless of size.

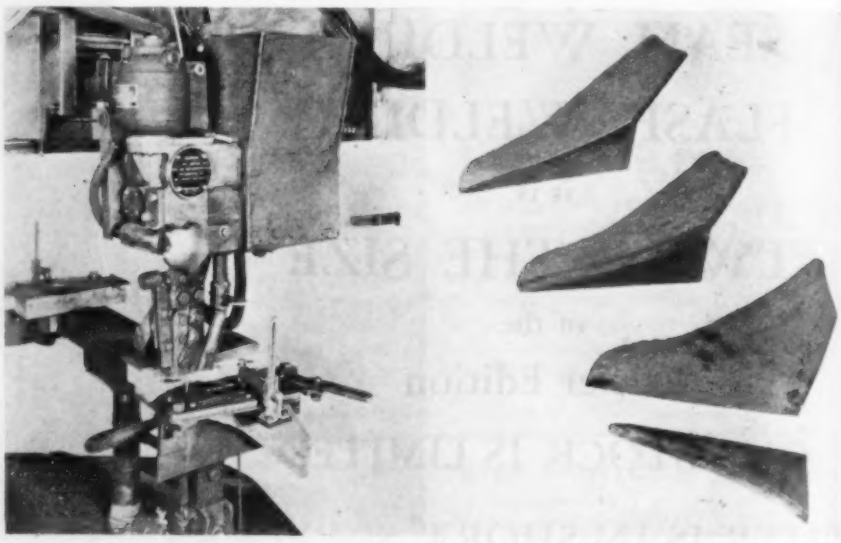
Shown in Figs. 2 and 3 are sketches of the nut and side-rail stock before and after welding. Important, according to Midland officials, is the correct dimensioning of the four projections in relation to the top shoulder, the base of the nut and the thickness of the stock to which it is being projection welded.

PLOW POINTS NOW WELDED AUTOMATICALLY

Production of plow points at Brinly-Hardy Co., Louisville, Kentucky, is now much greater with two men and modern automatic metallic arc welding than was formerly possible with three men and old-style hammer welding.

Production now with an automatic arc welder, (see illustration), is 100 points per hour. Economies are further increased by elimination of the fitting and polishing necessitated by heavy scaling encountered with hammer welding. Also eliminated by modern automatic arc welding are furnace expenses, including fuel and maintenance, also hammer maintenance. The arc welded plow point is also said to be more durable.

To date, more than 40,000 points have been manufactured by automatic arc welding which replaces the previous method of hammer welding which was in use 40 years.

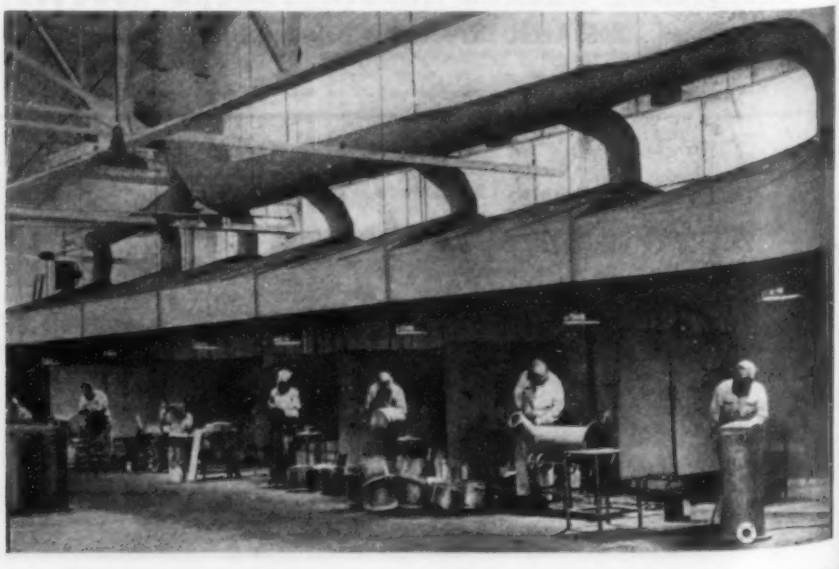


Photo, Courtesy Lincoln Electric Co., Cleveland, Ohio

Plow Points Welded Automatically

MODERN WELDING BOOTH SYSTEM

What is believed to be one of the most modern welding-booth systems in the country is the one at the Erie Meter Systems, Inc., Erie, Pa. Each booth has an individual exhaust outlet, arranged for each operator, which is so regulated that it may be turned off as desired. There is a large light in each booth. This light is strong enough to permit the operator to see the outlines of the piece on which he is working even though his shield is down.



"Bring me REVERE No. 456 LOW FUMING Bronze Welding Rod!"

FOR the bronze welding of cast and malleable irons, wrought iron, cast and wrought steel, cast and wrought bronze . . . use Revere No. 456. This Low Fuming Bronze Welding Rod produces strong, sound joints with tensile strength of approximately 56,000 to 67,000 p.s.i. It has the comparatively low melting point of 1600° F., which reduces the need for high preheats and post-heats. And it enables you to work in comfort because there are no excessive fumes.

You are always sure of top quality with Revere No. 456—the rod that is "flame-tested" to meet high performance standards.

Other Revere Welding Rods are: Revere Bronze 380, Manganese Bronze, Herculoy, Phosphor Bronzes, Brass (Brazing Rod), Silicon Deoxidized Copper and Electrolytic Copper. All come in 100-pound cases or in 25-pound cartons, net weight, and are stocked by Revere Welding Rod Distributors in all parts of the country. Write for folder giving technical data and net prices.

REVERE

COPPER AND BRASS INCORPORATED

Founded by Paul Revere in 1801

230 Park Avenue, New York 17, New York

Mills: Baltimore, Md.; Chicago, Ill.; Detroit, Mich.; New Bedford, Mass.; Rome, N.Y.—Sales Offices in Principal Cities, Distributors Everywhere.

NEW PRODUCTS

The Society assumes no responsibility for the validity of claims in this Section

CUTTING TORCH WITH MONEL HEAD

The popular Airco Series 9000 Cutting Torch with monel metal head and stainless steel tubes, discontinued during the war years because of a shortage of critical materials, is once again back on the market. This "quality" torch offers features not to be found in any other cutting torch. For example, the torch head, made of durable monel metal assures long trouble-free service; the tubes, made of stainless steel offer great rigidity and heat resistance; the stainless steel lever and ribbed handle have been expertly designed to afford maximum ease of operation. Moreover, all connections are silver brazed to assure permanent leak proof service.

In addition to its sturdy construction and modern design the Airco Series 9000 Cutting Torch is truly versatile. A total of 22 interchangeable cutting tips are available for this torch making it adaptable for every practical hand cutting operation from removing rivet heads by washing to cutting sheet metal and trimming plate.

The standard torch is 21 in. long and weighs 3 lb. and 4 oz. It is usually supplied with 75° or a 90° head but straight heads are also available. Swivel type hose connections for $^1/_4$ in. on $^5/_{16}$ in. I.D. hose are supplied with each torch.

For further information or descriptive literature on the Airco Series 9000 Cutting Torch write Air Reduction, 60 E. 42nd St., New York 17, N. Y. or the Airco sales office nearest you.

NEW TUNGSTEN ELECTRODES

A new line of tungsten electrodes for atomic-hydrogen and Inert-Arc welding has been announced by the Electric Welding Division of the General Electric Co. Suitable for manual or automatic welding, the new electrodes are free from nonmetallic inclusions, segregation, slivers, cracks, seams and pipes.

The new electrodes are available in diameters ranging from 0.040 to $^1/_2$ in., and in lengths from 3 to 24 in. Other lengths up to 60 in. can be furnished on request. Diameters are held to 0.001 in. tolerance.

PACKAGED RESISTANCE WELDING CONTROL

A line of synchronous-precision, a.-c. resistance welding controls in a complete, unified, factory assembled package is announced by Westinghouse Electric Corp., Buffalo.

Key to the new Synchro-Trol are the eight factory assembled subunits and the five supplementary subunits from which it is possible to make hundreds of combinations for timing and sequencing. Synchro-Trol makes installation easier for it eliminates the nuisances of complicated mountings and multiple connections between the conventional contactor, weld timer and sequence timer. It may be side-of-welder or floor mounted.

The finger tip control speeds production as each job can be quickly set. A transparent access door protects control setting against unauthorized tampering. Inspection is greatly simplified through a front access door. A swing-out feature of the cabinet provides access to the rear. Subunits are of the pull-out type and may be removed quickly for changes in control requirements by simply unloosening two wing nuts and disconnecting the plug connectors.

Maintenance is reduced by each and every part being readily accessible; by factory assembled subunits that are planned as an integral part of the whole control; by simplified circuits that mean fewer parts.

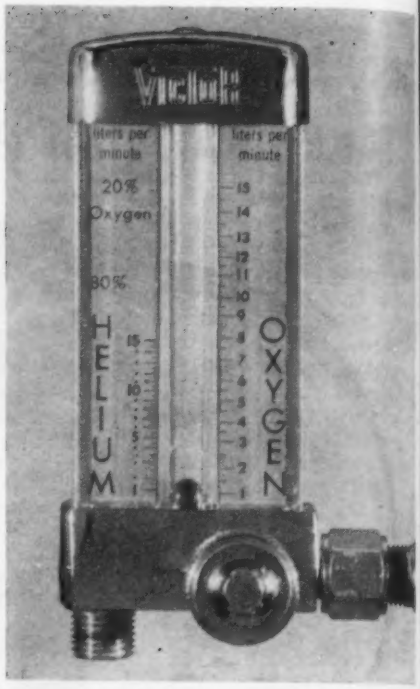
Further information on these welders may be secured from Westinghouse Electric Corp., P. O. Box 868, Pittsburgh 30, Pa.

INERT GAS CONTROL WITH SCIENTIFIC ACCURACY

Originally designed as the most modern and practical flowmeter ever offered to the medical profession, the Victrometer is also an important industrial control.

For inert arc gas welding the Victrometer can be furnished with graduations for argon and commercially pure helium and providing the same precision of control required for exacting medical standards. It is a modern instrument; accurate, sturdy, and requiring a minimum of care or repair.

Among the noteworthy features is the large black indicating ball which can be easily read from a considerable distance and the distinct calibrations which are clearly visible from both front and back of the Victrometer.



The single control wheel gives any fractional flow desired with accuracy... and maintains it uniformly. Consult the Victor Equipment Co. for control of inert gas flow for welding with accuracy and economy.

LARGE CUTTING TORCH

"A big, tough torch for the big, tough job" is what Liquid Carbonic Corporation's Wall Chemicals Division calls its new HC-39 "Pacemaker" cutting torch.

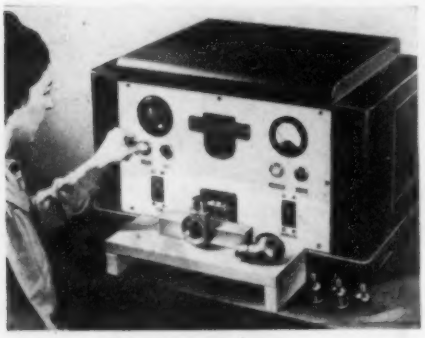
Designed with Gasweld's exclusive free flow mixing chamber, the torch has a recessed tip seat which prevents damage even if the torch should be dropped on its head. The hammer-end head provides additional strength to minimize the effect of rough usage.

Twenty inches long overall and weighing $3^1/_2$ lb., the Pacemaker is the biggest hand cutting torch in the Gasweld line. It is designed for use with Gasweld's tellurium copper cutting tips for acetylene-oxygen cutting.

FOR SHIELDED ARC
AUTOMATIC WELDING
RACO COMPOSITE TYPE "A"
THE NEW AND REVOLUTIONARY
ELECTRODE FOR AUTOMATIC
ARC WELDING
sizes: No. 6 (approx. 1/4"), No. 5 (approx. 7/32"), No. 4 (approx. 3/16"), and No. 3 (approx. 5/32"). Coils are 24 inches I.D., and weigh 150 to 200 pounds net.
LIGHTLY COATED AUTOMATIC ELECTRODES:—
RACO Types "D", "M", M-9 (Knurled), Plain Mill Finish and Copper Coated Wire in coils.
We also manufacture a full line of copper coated oxy-acetylene welding wires. Furnished in coils and straightened and cut lengths.
We further manufacture a complete line of heavy coated manual electrodes for welding:—Mild Steel—High Tensile Steels—Stainless Steel—Manganese Steel—Cast Iron—Nickel—Monel—Inconel and Aluminized Steel.
REID-AVERY COMPANY
INCORPORATED
DUNDALK • BALTIMORE 22 • MARYLAND
SINCE 1919 PRODUCERS OF ARC WELDING ELECTRODES AND WELDING RODS

THER-MONIC BENCH-TYPE INDUCTION GENERATOR

The Induction Heating Corp., New York, N. Y., largest producers of electronic heat-treating equipment, announces its entrance into the small unit field with the presentation of the Ther-Monic Model 43, 750 w., low-cost, bench-type induction heating generator.



This low-cost unit is ready for operation immediately upon delivery by simply plugging into any ordinary 120 v., 60 cycle, single-phase power supply outlet. The model 43 derives its model number from the standard Ther-Monic method of designating a unit according to its full-load output which is 43 Btu. per minute. This is equivalent to approximately 750 w. at a nominal operating frequency of 450 kilocycles per second.

The Model 43 combines the power section and work applicator in one unit and is an efficient source of high-frequency energy to speed up hardening, brazing, soft-soldering, annealing and melting operations. It is engineered for continuous full-load operation in the production line or for short run work. The coil leads are designed to facilitate frequent work change-overs involved in spot production, experimental or toolroom jobs.

This versatile bench-type generator lends itself to all types of mechanization such as conveyor belts, turntables, rotary spindles for automatic feed or shop-made fixtures for manual feed.

The steel cabinet of the Ther-Monic Model 43 is 29 in. long, 16 1/2 in. high, 19 5/16 in. deep and is equipped with four recessed handles for easy portability.

WATER-COOLED "HELIARC" WELDING TORCH

A new water-cooled "Heliarc" torch designed for inert-gas-shielded arc welding has been announced by The Linde Air Products Co., Unit of Union Carbide and Carbon Corp. Known as the HW-4, this torch features water cooling, a lightweight flexible power cable, a gas cup made of non-conducting material, and an easily adjusted tungsten electrode. The torch head and handle and the gas cup are fully insulated.

Water-cooling the torch makes possible the use of an unusually light and flexible power cable capable of carrying 250 amp. Cooling water flows through the torch and handle and out around the power-supply

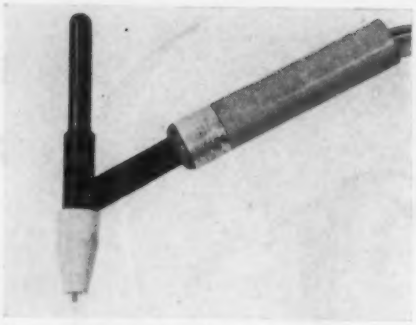


Fig. 1—The New HW-4 "Heliarc" Welding Torch

cable. A safety fuse is inserted in the water discharge line to shut off the power if the water should stop flowing, or the torch become overheated. Direct current, straight or reverse polarity, or high-frequency stabilized alternating current can be used.

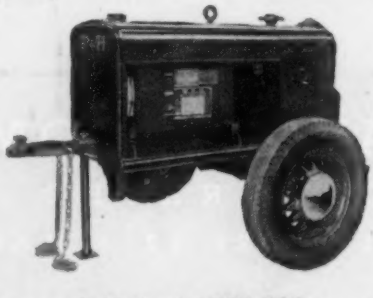
A fully insulated ceramic gas cup directs the flow of gas to the weld area, completely blanketing the electrode, arc and molten metal from the atmosphere. The insulated cup prevents accidental arcing to adjacent parts of the workpiece or jig. An electrode extension with a removable cap permits easy adjustment of the virtually non-consumable tungsten electrode.

The "Heliarc" process employs the principle of shielding the weld area from the oxidizing atmosphere under a blanket of inert, monatomic gas, such as argon. Metals such as stainless steel, aluminum, Monel, Inconel, and magnesium are welded rapidly and without the use of flux with this process. The process overcomes previous difficulties in welding corrosion-resistant metals. The new HW-4 "Heliarc" torch should be increasingly used in the "Heliarc" welding of such alloys and metals. Its sturdy, lightweight construction and full insulation assure safe and efficient operation.

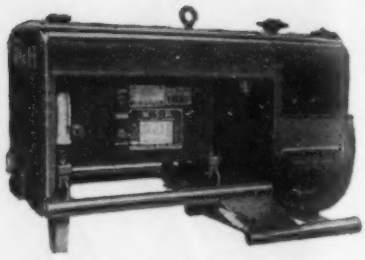
PORTABLE WELDER

A new self-powered arc welder, designed for shop, yard and field service, is now offered by Harnischfeger Corp., Milwaukee, Wis.

The P&H Model WN-200 Welder, available as a stationary or trailer unit, is an N.E.M.A. rated machine of 200 amp., but has a welding service range of from 30 to 260 amp. Both types have engine and welder securely mounted on an all-welded



P&H Model WN-200
Trailer Welder



P&H Model WN-200
Welder as stationary unit

frame of sturdy steel tubing and heavy angle iron. The skid model is ideal for carrying on trucks. A large lifting eye for crane lifting is provided.

The trailer model has been engineered especially for use in the field. Carried on a running gear of standard track width, the trailer welder has standard size pneumatic tires as regular equipment. Tests have proved this model tracks very easily over the back roads where the going is rough and it tows at normal highway speeds with a complete absence of side sway. Running reflectors are attached to the trailer body for safety on the highway. There is an adjustable front end supporting stand for use when the welder is standing alone. A ball and socket hitch and safety chains are provided.

Both models are equipped with P&H's well-known square frame arc welding generators, having a welding service range of from 30 to 260 amp. There is just one control for any desired welding heat from minimum to maximum capacity. Arc response is automatic on all classes of work and with all types of electrodes. Like all P&H Arc Welders, the new model WN-200 also has "Visi-matic" calibration plates which enable the operator to select instantly the exact welding current for each of the three classes of electrodes.

Literature describing both P&H Models WN-200 Portable Welders can be obtained by writing Harnischfeger Corp., Welding Division, 4400 W. National Ave., Milwaukee 14, Wis.

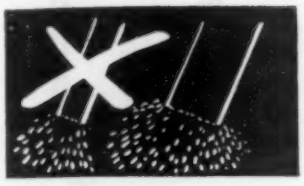
AIRCO ANNOUNCES ADDITION OF WYPO TIP CLEANERS

The addition of Wypo tip cleaners, for use in cleaning oxyacetylene welding and cutting tips, to their line of apparatus has been announced by Air Reduction Sales Co., 60 East 42nd St., New York 17, N. Y.

The economically priced sets of Wypo tip cleaners are available in two individual packages known as Set #1 and Set #2. Set #1 contains 12 cleaners for drill sizes ranging from #75 to #49. Set #2 contains 9 cleaners for drill sizes ranging from #48 to #30. The Wypo tip cleaners are made of corrosion resistant stainless steel and each set comes in a compact, easy-to-carry, leather case.

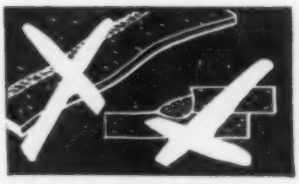
Effective immediately sets of Wypo tip cleaners will be displayed on counters and in show windows of Airco retail stores and district offices throughout the coun-

(Continued on page 546)



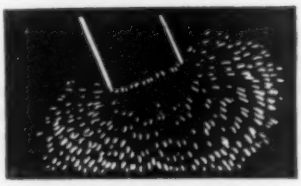
LARGER ELECTRODES MEAN LOWER COSTS

You get faster deposition with "AC-3" because you use a larger size to weld lighter steels. Try it and prove to yourself the real savings this P&H Electrode makes possible.



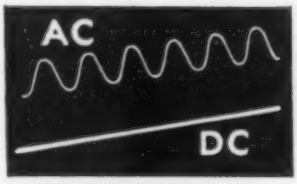
CUTS DISTORTION AND UNDER-CUTTING

Yes, "AC-3" minimizes these troubles to save more time, prevent waste. "AC-3" is a general-purpose P&H electrode for welding both thin and heavy steels.



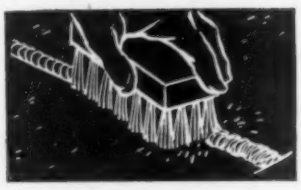
SPRAY-TYPE ARC

With this "spray-type" electrode, tiny particles of metal diffusing across the arc, produce smooth, flat deposits. Finishing is reduced to a minimum or eliminated.



FOR AC OR DC

This P&H Electrode was designed for easy welding on both AC and DC current. So whatever your machines, whatever your work, "AC-3" can speed up welding and lower costs.



SLAG REMOVAL IS NO PROBLEM

Another fine characteristic of "AC-3" is its unusual slag — it virtually "curls off." Think what this means; no extensive time-taking chipping or cleaning operations.

P&H

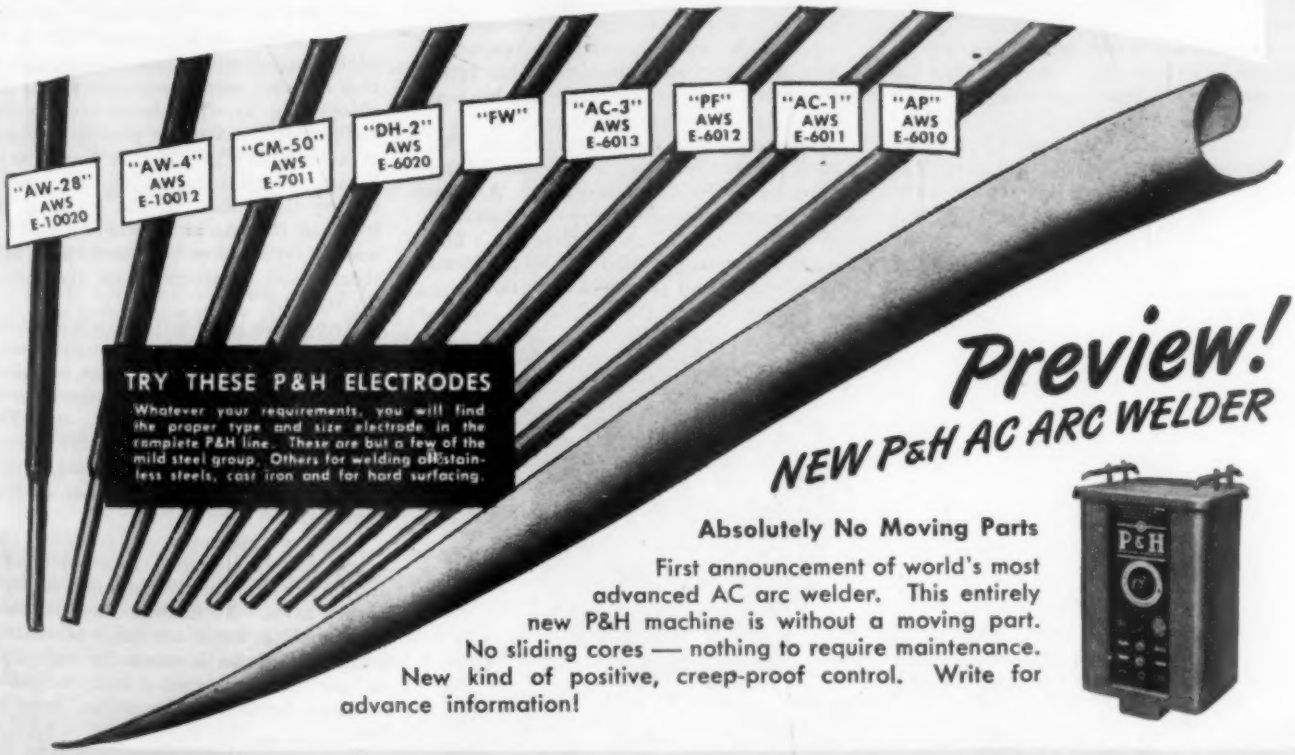
WELDING ELECTRODES

4551 W. National Avenue

Milwaukee 14, Wisconsin

HARNISCHFEGER CORPORATION

WELDING ELECTRODES • MOTORS • HOISTS P&H ELECTRIC CRANES • ARC WELDERS • EXCAVATORS



TRY THESE P&H ELECTRODES

Whatever your requirements, you will find the proper type and size electrode in the complete P&H line. These are but a few of the mild steel group. Others for welding all stainless steels, cast iron and for hard surfacing.

Preview!

NEW P&H AC ARC WELDER

Absolutely No Moving Parts

First announcement of world's most advanced AC arc welder. This entirely new P&H machine is without a moving part. No sliding cores — nothing to require maintenance. New kind of positive, creep-proof control. Write for advance information!

AMERICA'S MOST COMPLETE WELDING SERVICE

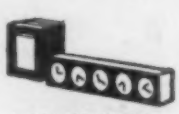
WELDING ELECTRODES

WELDING POSITIONERS

ELECTRIC HOISTS

DC WELDERS

AC WELDERS



WELDING PRODUCTION CONTROL SYSTEMS

(*Continued from page 542*)

try. Further information regarding the Wypo tip cleaners may be obtained by writing Air Reduction's New York office or the Airco sales office nearest you.

NEW PORTABLE UNIONMELT WELDING MACHINE

A new portable automatic welding machine, built especially for welding light-gage sheet and light plate by the Unionmelt process, has been developed by The Linde Air Products Co., Unit of Union Carbide and Carbon Corp. Unionmelt welding is the process of welding electrically beneath a layer of granulated mineral composition without visible arc. The Unionmelt DS-37 Welding Machine is small and light in weight, and provides for an extremely simple control of welding conditions.

Features of Machine

Since the machine weighs only 190 lb., it can be moved from one location to another as the work may require.

The machine can be placed directly on the work and hand-guided, or it can be mounted on standard track or guided by a small structural angle clamped to the work for production welding.

Extensions are available for lengthening the nozzle assembly when making non-positioned fillet welds or welds below the level of the carriage. The welding head can be swung forward through 45°, tilted at any desired angle to either side, or positioned anywhere in a circle around the carriage. The head supporting arm can be extended as much as 5 in. The head also has a vertical adjustment of 5 in. or it can be set to permit vertical motion as the guide wheel follows the surface of the work piece. Small vertical and lateral adjustments for positioning the welding head can be easily and quickly made by means of handwheels.

The Type D series control is mounted within the plastic rod reel frame and thus all controls necessary for welding are within easy reach of one operator. The welding head and rod reel are mounted on a CM-37 high-speed carriage, which has accurate, stepless speed control from 7 to 210 in. per minute. The welding head without the carriage can be used for a stationary installation.

Capacity of Machine

The DS-37 Machine will butt-weld, in a single pass, material from 16 gage to $^3/_4$ in. thick. It will also make, in a single pass, positioned fillet welds with legs measuring $^1/_8$ to $^3/_4$ in.; non-positioned fillet welds with legs from $^1/_8$ to $^3/_8$ in.; and plug welds in material $^1/_4$ to $1^1/_4$ in. thick. Material of any thickness can be welded by using multipasses. Welding currents up to 1200 amp. can be applied and coiled welding rods of $^3/_{32}$ to $^1/_4$ in. diameter can be used.

25-TON HYDRAULIC PRESS

A new 25-ton hydraulic press, known as the Model 25H, is announced by Dake Engine Co., Grand Haven, Mich. This press meets the need for an intermediate size press, and complements the large variety of Dake Presses available up to 75-ton capacity. It is built for use in maintenance, service and industrial plants requiring a 25-ton hydraulic press.

This new press features a fast-moving ram which saves considerable operating time over previous presses of this type. The extra speed of operation is obtained by using an extra-large pump.

Like all Dake hydraulic presses, this press is constructed with arc-welded steel channel, reinforced throughout. A large space between uprights allows the handling of work up to $33^1/_2$ in. in diameter. The screw-type ram provided can be advanced quickly by hand to speed operation.

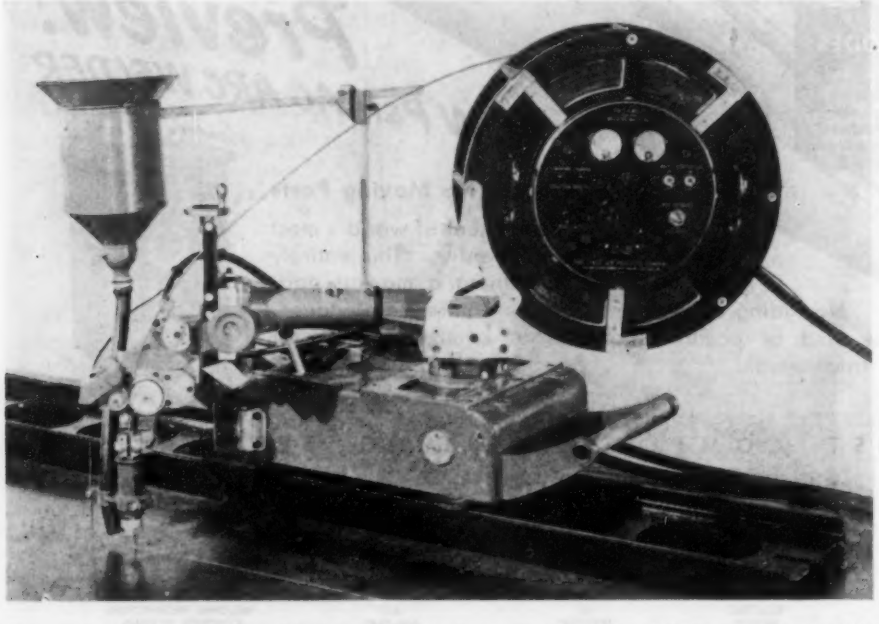
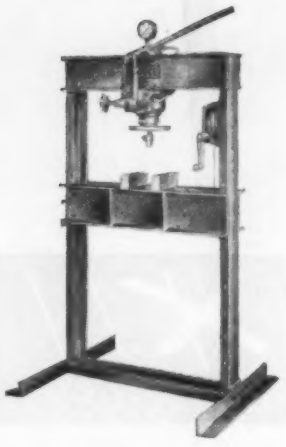


Fig. 1—The DS-37 Welding Machine, Mounted on a Standard Track Is Frequently Used for Production Operations



Standard equipment includes two combination table and V-blocks, round nose for pressing, pressure gage, and table-hoisting mechanism. The press can also be furnished less the gage and less the table hoisting mechanism.

PEDESTAL LINE WELDERS

A new improved line of 30, 50 and 75 kva. pedestal-type spot-welding machines has been introduced by Progressive Welder Co., 3050 E. Outer Drive, Detroit. While designated as "economy" type machines, since they represent relatively low initial cost, they are not "light duty" in design.

As a matter of fact, frame construction in these machines compares favorably with that of much more costly heavy duty machines (Fig. 2). This frame construction, incidentally, has made possible a degree of accessibility not usually found in resistance welding machines. By concentrating the "beef" in the frame at the front of the machine—where rigidity is needed—it has been possible to use a light sheet metal construction for the rear of the machine.

Removable sheet metal panels and a full length door on the left side supplies complete accessibility to all units contained in the machine, including transformer, heat controls, water piping, etc. The right side of the machine column is completely clear so that it can be used for side mounting of electronic or other welding controls.

From a performance standpoint, the machines are designed to provide both adaptability for job welding runs and high output rates. To facilitate miscellaneous spot welding, knees are quick-adjustable, maximum stroke is unusually high ($2^1/_2$ in.) and different types of interchangeable electrode holders are available. Setup is fast.

High productivity rates are insured by the speed of machine operation. The welding head is of low inertia, for fast action with this in view. Maintenance of constant machine performance is aided by the feature of visible water circulation through three separate supply systems—one for each electrode, one for the transformer.

Correct pressure regulation is made easy by providing a pressure gage at the

ANNOUNCING the ML-5604

(water cooled type ML-5619)

Specially designed to meet the severe conditions of RF heating service

Machlett Laboratories now makes available, for early delivery, two new tubes—the ML-5604 for forced air cooling and the ML-5619 for water cooling—both specifically designed to withstand the rigorous and non-uniform operation inherent in industrial heating applications. In the development of every feature of these tubes, such conditions as widely varied loads, severe vibration, heavy irregular physical shocks and operation by personnel untrained in electronics, have been given full consideration.

A. **Heavy wall high conductivity copper anode—specially processed.**

B. **One piece high conductivity copper grid and filament support terminals . . . for maximum strength, minimum lead resistance and elimination of electrode distortion.**

C. **Improved filament spring design. Minimizes bowing and increases filament life.**

D. **Chemically cleaned, vacuum fired internal parts for longer life and stable operation.**

E. **Stronger self-supporting grid for uniform electron control.**

F. **Rugged kovar grid and filament seals.**

G. **Rigidly supported grid and filament assemblies. Glass surfaces completely shielded against electron bombardment and radiant filament energy.**

H. **Glass contour provides long leakage path and more efficient cooling.**

I. **Rugged kovar plate seal located in air stream.**

J. **Gold plated contact surfaces. Insure permanent low contact resistance.**

These completely new tubes are an outstanding contribution to industrial electronics. They may, of course, also be used for communications purposes. For further information, write Machlett Laboratories, Incorporated, Springdale, Conn.

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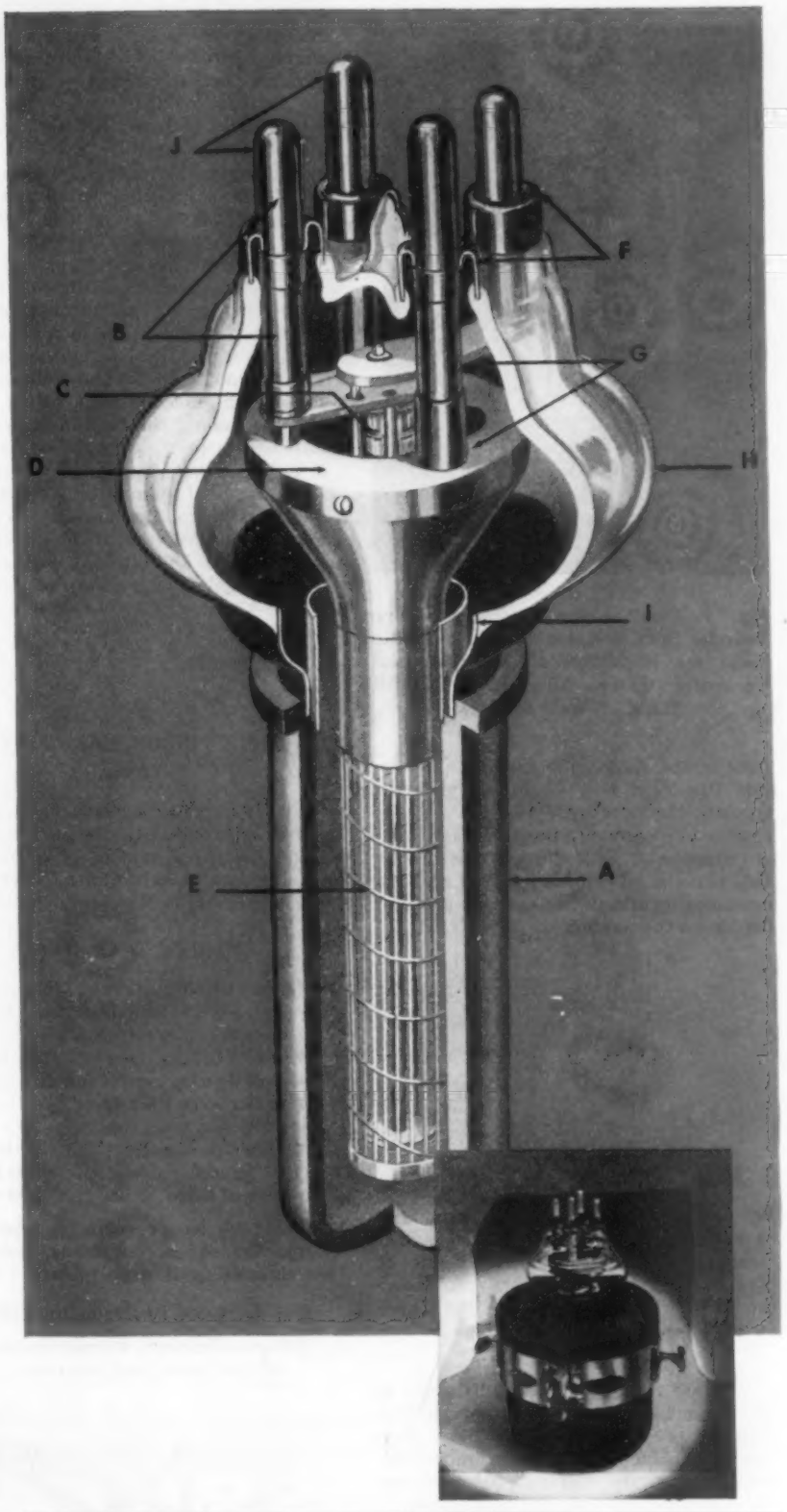
50 YEARS OF ELECTRON TUBE EXPERIENCE



ML-5604

TRIODE R.F. HEATING OSCILLATOR AND POWER AMPLIFIER

Filament	Tungsten
Voltage	11.0 a.c. Volts
Current	180 Amps.

Starting: The filament current must never exceed 270 Amps., even momentarily.

AMPLIFICATION FACTOR: 18.5

DIRECT INTERELECTRODE CAPACITANCES:

Plate to Grid	25 mmfd
Plate to Filament	1.25 mmfd
Grid to Filament	30 mmfd

COOLING: Minimum air flow through radiator 750 c.f.m. @ 1.25" back pressure.

Minimum air flow of 15 c.f.m. from 3" nozzle on center of dish.

OPERATION:

Maximum ratings, Absolute values:

D.C. Plate Voltage (Note 1)	10000 max. Volts
D.C. Grid Voltage	−2000 max. Volts
D.C. Plate Current	2.75 max. Amps.
D.C. Grid Current	.40 max. Amps.
Plate Input (Note 2)	27.5 max. KW
Plate Dissipation (Note 3)	10 max. KW
Max. Frequency for full ratings	30 mc
Max. Anode Temperature	230° C
Max. Glass Temperature	160° C

(Note 1): For operation below 5 mc. 12,500 max. D.C. plate volts may be used.

(Note 2): For operation below 5 mc. Plate Input may be 32.5 KW max.

(Note 3): Plate Dissipation water-cooled (Type ML-5619) 20 KW max.

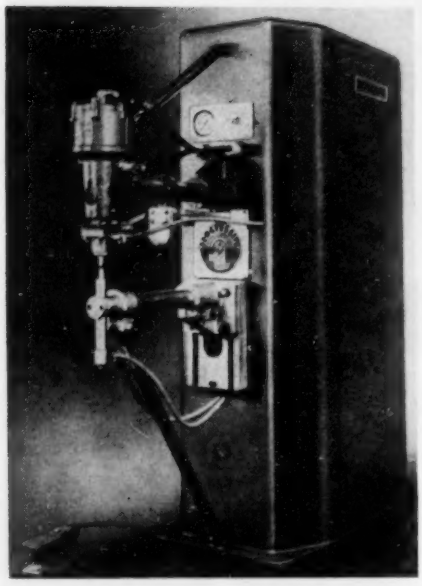


Fig. 1—One of the New Progressive Pedestal Spot Welders with Low Inertia Head for High Speed Operation and Unusually Quick Adaptability to All Kinds of Welding Jobs

front in the head of the machine. Alongside this gage is a knob to accurately regulate the pressure. Air filter and air system lubricator are furnished as standard equipment with the machines. The only periodic lubrication required on these machines is through two external pressure fittings on the welding head.

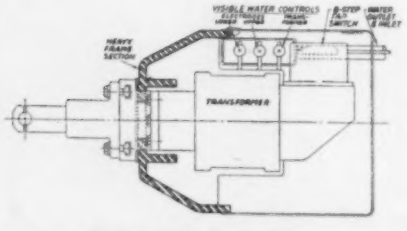


Fig. 2—Section Through Column of One of the New Pedestal Welders. Note That Strength Is Concentrated at Points of Maximum Stress. This Views Also Shows the Visible Water Outlets for the Three Separate Cocling Systems

Welding arms are of large diameter, it will be noted, extending the frame rigidity right to the electrode point. For deep throat machine support, arms bracing the welding arms are recommended to obtain maximum benefit from the rigid frame.

Jobs normally requiring swiveling arm construction to clear the work can be easily handled on these machines as the result of the large throat opening (up to 12½ in.) provided.

CAST-IRON SOLDER ROD

All-State Welding Alloys Co., Inc., 96 West Post Road, White Plains, N.Y., announces the immediate availability of a new cast-iron solder rod for repairing cracks on cast iron. Field tests have shown that this is the first cast-iron solder that combines real ease of application with highly satisfactory results. This rod produces corrosion-resistant welds and is excellent for repairing cracks in cast iron which must be water-tight and pressure-tight against pressures up to 1000 psi. It is also used for sealing and filling cracks and blowholes and for building up where strength is not required. It melts at a very low temperature, 600° F., and tins easily and exceptionally rapidly.

This rod produces particularly good results in many types of automotive repair jobs; it is used for such applications as building up broken corners and low spots in motor blocks and cylinder heads, for soldering cracked heads on car motors, and for tinning the bottom outlet of car radiators in preparation for soft-soldering it to the copper bottom of the radiator. It is also used for replacing eroded areas on salt-water marine engines. This rod, known as All-State No. 7 cast-iron rod, is used with All-State No. 7 flux, except for brazing dissimilar metals to aluminum, where All-State No. 53 flux is used.

PORTABLE INDUSTRIAL ELEVATING TABLE

The Industrial Elevating Table is made of steel throughout, designed to safely carry and lift a load of one ton. It is sturdily built with nothing to get out of order and remains fixed in any position.

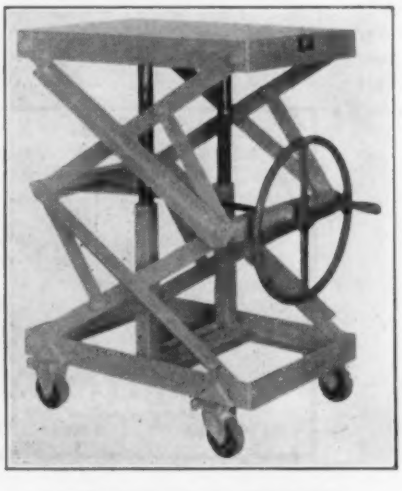
SPECIFICATIONS

Minimum height from floor.	26 In.
Maximum height from floor.	43 In.
Raise per revolution of hand wheel.....	⅜ In.
Two Ball Bearing Swivel and Two Stationary Casters..	4 In. Diam.
Dimensions of table top....	20 x 32 In.
Overall width of table.....	26 In.
Weight (crated).....	290 Lb.
Capacity of table.....	2000 Lb.

This table has proved a big labor saver in machine shops, tool rooms, punch and plastic molding die departments.

One man can easily do the following:

Remove dies from storage shelves, convey and place them in presses.



Support and level large overhanging pieces of work on drill presses, etc.

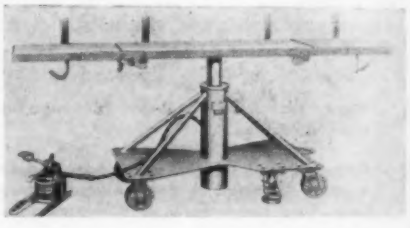
Re-arrange punch press, mold dies and other heavy parts on shelves in stock rooms.

Transfer heavy work from horizontal mills to drill presses and do many types of heavy handling.

HYDRAULICALLY OPERATED STRIP AND SHEET FEEDING TABLE

For feeding strip or sheet metal to shears, rolling mills, punch presses, and similar applications, LYON-Raymond Corp. now offers a specially adapted hydraulic elevating table.

This table is designed to accommodate bundles of stock, loaded by means of overhead hoists or fork trucks. Its elevating feature will enable a machine operator to keep stock at the desired height for feeding into dies or shears and will eliminate awkward manual handling and the bending of stock.



Since this Strip and Sheet Feeding Table is portable, it can readily be moved with stock to another press in case of die breakdown. The pump is joined to the central cylinder by flexible hose which permits placing of the pump where it is most convenient to the machine operator—it may be suspended from the table top when it is necessary to move the table.

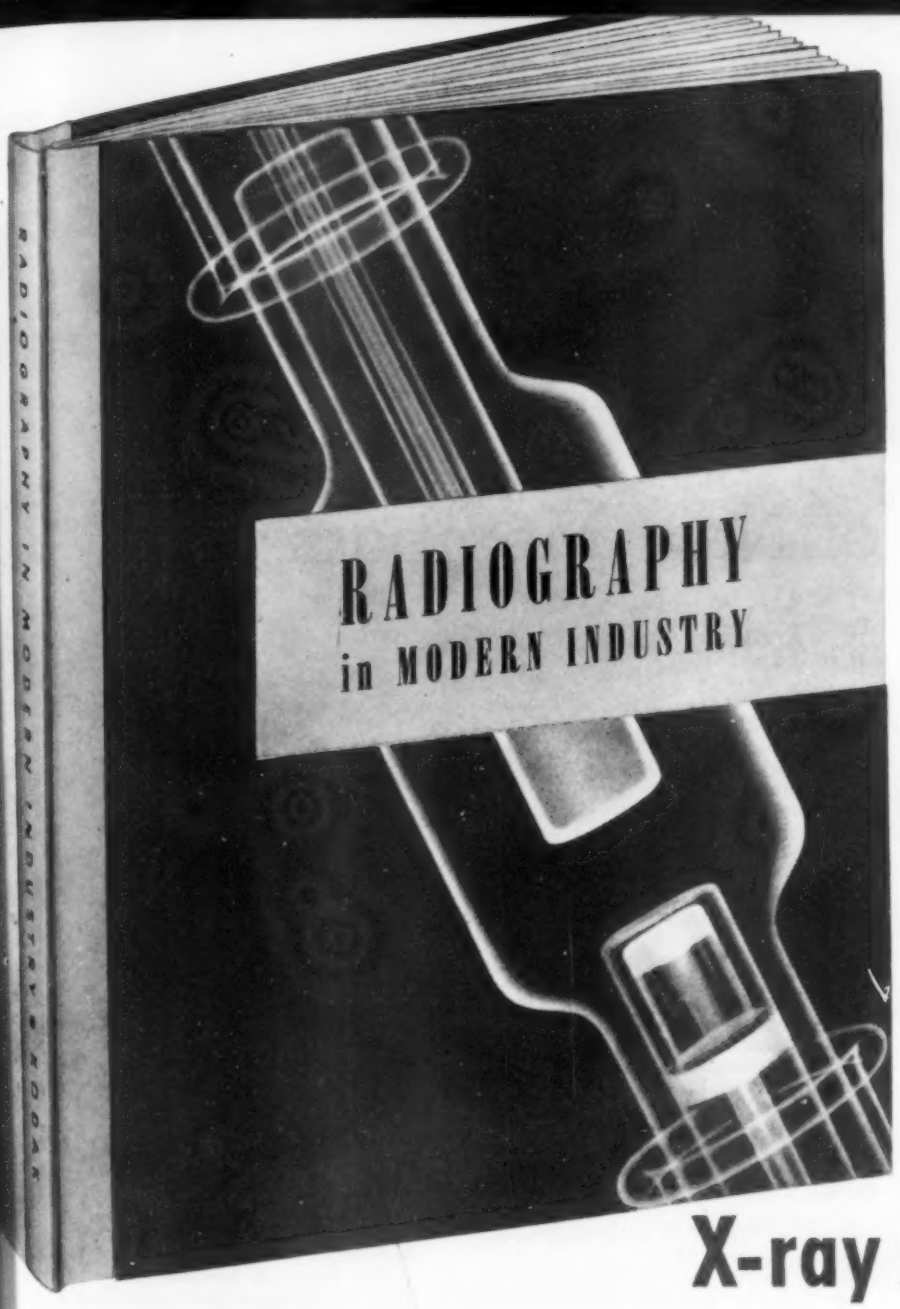
The table top consists of one rigid section, same length as the base, plus two removable extensions designed to support longer loads. If it is desired to store the table in a minimum space the extensions are removed by simply lifting to a vertical position.

For additional information address LYON-Raymond Corp., 3457 Madison St., Greene, N.Y.

IMPROVED AIRCO NO. 190 ELECTRODE

An improved Airco No. 190 electrode, which was originally developed for use by the aircraft industry in welding assemblies to be heat treated after welding, has been announced by the Air Reduction Sales Co., 60 E. 42nd St., New York 17, N. Y.

The improved Airco No. 190 has two important advantages over its predecessor. One, when welding high strength chrome-moly aircraft steels, the necessity for preheating is minimized. Also, this electrode is less conductive to cracking adjacent to the weld area and between the layers of weld metal when preheating is not employed. This electrode will give tensile



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strengths up to approximately 150,000 psi. and produce welds more ductile than those previously obtained.

Although particularly applicable to the aircraft field, this electrode can also be used on alloy steels where high tensile strengths are required.

Airco No. 190 electrode is recommended for operation on direct current, straight polarity or on alternating current. The medium-long arc is suggested for best results. It can be obtained in $^3/_{32}$, $^1/_8$, $^5/_{32}$ and $^3/_{16}$ in. diameters and is immediately available.

For further information write to the address above or the Airco sales office nearest you.

List of New Members

April 1 to April 30, 1947

BIRMINGHAM

Bailey, John P. (C), Geslin Birmingham Mfg. Co., 3700 10th Ave. N., Birmingham, Ala.

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CHICAGO

Grambo, Frederick J. (C), 6716 Calumet Ave., Hammond, Ind.
Sianta, George (B), 1321 S. 58th Ave., Cicero 50, Ill.
Smith, Albion E. (C), Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Smith, Benjamin F. (C), Elko Hotel, East Chicago, Ind.
Stolaz, Emil A. (C), 13221 Exchange Ave., Hegewisch, Ill.
Toren, John (C), Graver Tank & Mfg. Co., Inc., 4809 Todd Ave., East Chicago, Ind.
Wilkin, L. A. (C), Graver Tank & Mfg. Co., Inc., 4809 Todd Ave., East Chicago, Ind.

CINCINNATI

Scott, Thomas T. (B), Cleveland Automatic Machine Co., Norwood, Ohio.

CLEVELAND

Selby, Joseph C. (B), c/o Steel & Tube Div. Library, Timken Roller Bearing Co., Canton 6, Ohio.

COLORADO

Binkley, Wm. D. (B), P. O. Box 4120, S. Denver Sta., Denver 9, Colo.
Fry, J. L. (B), 916 Gas & Electric Bldg., Denver, Colo.
Mathias, Paul C. (B), Opportunity School, 13th & Welton, Denver, Colo.
Winslow, Maurice (C), 925 Euclid Way, Denver, Colo.
Woerner, Irvin A. (B), Heath Engrg. Co., 209 Jefferson, Fort Collins, Colo.

COLUMBUS

Craft, Clark H. (D), Cumberland, Ohio.
Hanes, Walter W. (C), 572 Clark Ave., Columbus, Ohio.
Kearns, William H. (D), 176 W. Weber Rd., Columbus 2, Ohio.
Ross, Walter W. (D), 15 E. 14th Ave., Columbus, Ohio.
Seymour, Homer A. (B), 221 College St., Groveport, Ohio.
Smith, Yost T. (D), 232 W. 2nd Ave., Columbus, Ohio.
Traxler, Fred E. (B), 1215 Broadview Ave., Columbus, Ohio.

DAYTON

Allen, Clarence L. (C), 2313 Fauver Ave., Dayton, Ohio.
Fleisch, Harold (C), 39 E. Third St., West Alexandria, Ohio.
Zimmer, Jesse L. (B), 142 Bish Ave., Dayton, Ohio.

DETROIT

Bedell, Thomas G. (C), 507 Third St., Bay City, Mich.
Chouaniec, Frank (C), 4415 Sheridan Rd., R. 1, Saginaw, Mich.
Collins, Harry, Jr. (B), Electroloy Co., Inc. 6-251 General Motors Bldg., Detroit, Mich.
Cribbins, Louis O. (C), 3131 Carrollton Rd., Saginaw, Mich.
Dockson, Sterling Howell (B), Dockson Prods., 6813 E. Eight Mile Rd., Base Line, Mich.
Jamieson, Reginald (C), 741 Suffield Rd., Birmingham, Mich.
Klas, Joseph (B), 610 Farmdale, Ferndale 20, Mich.
Smith, Knowles B. (C), 424 Book Bldg., Detroit 26, Mich.
Woodward, Allen A. (C), 603 Rosewood, Ferndale, Mich.

HARTFORD

Corbett, S. C. (B), Round Hill Rd., Bristol, Conn.
Michand, Leo L. (B), 50 Putnam St., Bristol, Conn.

INDIANA

Baker, R. E. (B), Glascock Bros. Mfg. Co., Muncie, Ind.
Collins, Donald L. (D), 900 N. Main St., Kokomo, Ind.
Crook, Henry (B), Glascock Bros. Mfg. Co., Muncie Ind.
Strohm, Harry (B), Glascock Bros. Mfg. Co., Muncie, Ind.
Yingst, James A. (B), Glascock Bros. Mfg. Co., Muncie, Ind.

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Knox, Frank F. (C), 307 S. 15th St., Coeur d'Alene, Idaho.
Pfost, George R. (C), Box 283, Rt. 3, Coeur d'Alene, Idaho.

KANSAS CITY

Lauver, Frederick W. (C), Fred's Portable Welding Service, 1752 Washington St., Topeka, Kan.
McClure, W. J. (B), Kansas State College, Shop Practice Dept., Manhattan, Kan.

LEHIGH VALLEY

Marsh, Emmet C. (C), Commercial Gas Corp., 286 Carey Ave., Wilkes-Barre, Pa.
McGeady, Leon J. (C), Lehigh University, Dept. of Metallurgy, Bethlehem, Pa.
Rothrock, William F. (C), R. D. 2, Bath, Pa.

LONG BEACH

Smith, Orin (C), 2930 Longbeach Blvd., Long Beach 7, Calif.

LOS ANGELES

Armbruster, William H. (C), 6927 Bonsallo Ave., Los Angeles 44, Calif.
Bergman, Elmer O. (B), C. F. Braun & Co., 1000 S. Fremont Ave., Alhambra, Calif.
Cowles, Kenneth C. (C), 4401 E. 52nd St., Maywood, Calif.
Crispin, J. Hewes (C), C. F. Braun & Co., 1000 S. Fremont Ave., Alhambra, Calif.
Daly, Maurice (C), 327 S. Moore Ave., Monterey Park, Calif.
Hendrix, Addison E. (C), 917 W. 58th St., Los Angeles 37, Calif.
Kemp, Frank W. (C), C. F. Braun & Co., 1000 S. Fremont Ave., Alhambra, Calif.
Kilgore, Richard R. (C), P. O. Box 7336, Station L, Los Angeles 23, Calif.
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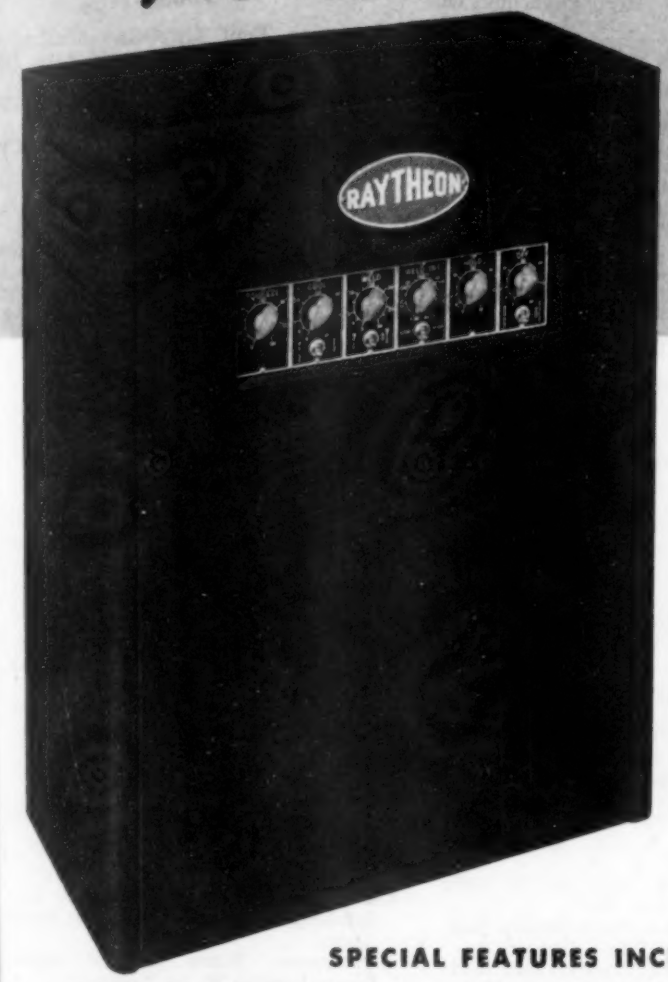
The new line of RAYTHEON

NON-SYNCHRONOUS CONTROL . . .



The many new and exclusive features incorporated in Raytheon Non-Synchronous Controls make this line outstanding in the field.

These units are used with air or hydraulically operated resistance welders to provide accurate electronic control of all mechanical functions, and non-synchronous timing of application of welding power.

Write for illustrated Technical Bulletin

SPECIAL FEATURES INCLUDE:

SEQUENCE-WELD TIMER designed to give full range of timing as specified by NEMA.

IGNITRON TUBE CONTACTOR using standard tube sizes.

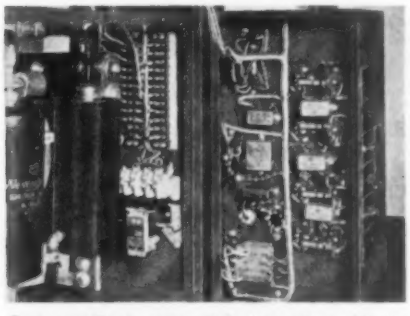
CABINET ONLY 28″ high, 21″ wide, 10″ deep contains sequence-weld timer and standard Ignitrons up to size C. (Timer and contactor taking size D Ignitrons slightly larger.)

EASILY INTERCHANGEABLE . . . all styles of timers built on common chassis which fits into timing compartment. Permits ready substitution of NEMA 5B timer in place of 3B.

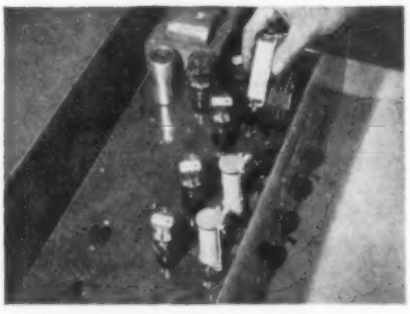
TIMER REMOVABLE without disconnecting, permitting ready inspection of components during operation.

TELEPHONE-TYPE PLUG-IN relays in sequence-weld timer are easily removed, simple to check, quickly replaceable.

QUALITY COMPONENTS, advanced design and simple circuiting assure accuracy and long life.



Sequence Timer removed for inspection while in operation condition, with all parts exposed for checking.



Top view of 3B Sequence Timer partly removed. Unit readily converted to 24 volt, single or two position, or 110 volt two position operation, by plugging accessory relays into sockets.

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Morrison, Lambert V. (C), 837 E. Lime Ave., Monrovia, Calif.
O'Connor, Raymond D. (C), R. C. Brown Welding & Supply, 139 E. Commercial St., Pomona, Calif.
Parker, Vincent L. (C), 1422 S. Raymond Ave., Alhambra, Calif.
Uhl, Vincent A. (C), 427 S. McPherrin Ave., Monterey Park, Calif.
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Vandel, Floyd (C), 700 Willow Spring Rd., Dundalk 22, Md.

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Selter, Ernest W. (D), 426 Hutchinson St., Trenton, N. J.
Yowpa, John (D), 331 Florence Ave., Hillside, N. J.

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Maher, J. V. (B), The Linde Air Products Co., 30 E. 42nd St., Rm. 703, New York 17, N. Y.
Palmer, Earl F. (B), Heyden Chemical Corp., Morgantown, W. Va.
Rees, N. John (B), Socony Vacuum Oil Co., 154 Nassau St., New York 7, N. Y.
Stewart, John T. (B), 156-06—46th Ave., Flushing, L. I., N. Y.
Tibbetts, E. F. (B), The Lummus Co., Graybar Bldg., 420 Lexington Ave., New York, N. Y.

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Hechtman, Robert A. (C), University of Illinois, 116 Talbot Lab., Urbana, Ill.

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Di Pietro, Frank A. (D), 85 Tremont Ave., Newark, N. J.
Durkin, Thomas A. (C), 124 W. 11th Ave., Conshohocken, Pa.
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South, John E. (B), Pennsylvania Railroad, 450 30th St., Station, Philadelphia 4, Pa.

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Smalley, Harold J. (B), 69 Arbordale Ave., Rochester 10, N .Y.

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De Garmo, E. Paul (B), University of Calif., Engineering Bldg., Berkeley 4, Calif.
Kerr, James E. (B), 1025 Lemon Ave., Menlo Park, Calif.

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Hartman, H. F. (C), Humble Oil & Refining Co., Baytown, Tex.

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Augustine, Emil (C), Ocean Accident & Guarantee Corp., Ltd., 514 Atlas Life Bldg., Tulsa, Okla.
Brechtel, Orden (B), P. O. Box 2265, Tulsa, Okla.
Looney, R. L. (B), Lincoln Electric Co., Box 870, Tulsa, Okla.

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Chen, Ching Fu (C), c/o Chien Chow, 2224 R St., N. W., Washington 8, D. C.
Lancaster, Fred G., Jr. (B), Aluminum Co. of America, 605 Southern Bldg., Washington 5, D. C.

WESTERN MICH.

Nickell, Elwood L. (C), E. L. Nickell Co., Constantine, Mich.

WESTERN N. Y.

Deux, Justus A., Sr. (B), Henry H. Hill, Inc., 447–449 N. Union St., Olean, N. Y.

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Neunberg, Hubert W. (B), 314 Main St., Gardner, Mass.

YORK-CENTRAL PA.

Allen, Frank J. (B), York Corp., York, Pa.

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Jacobs, Lionel Frank (B), Scarborough, Hillside, Bulawayo, S. Rhodesia, South Africa.
Lundgren, Sture (B), Blasieholmsgatan 3, Stockholm, Sweden.
Rastrick, Ronald J. (B), Canterbury College, School of Engineering, Christchurch, N. Z.
Skarpisek, Ing. Jan (B), Choteborske Kovodelne Zavody, Chotebor Metal Industries, Chotebor, Czechoslovakia.
Trap, Mr. A. P. J. (B), c/o N. V. Handelsvereeniging, Amsterdam, P. O. Box 583, Amsterdam, Holland.
Tsou, Shang-Jen (C), c/o Chung Yuan Paper Mfg., Ipin, Szechuan, China.
Ward, Ralph G. (C), Via Palmer, Glen Allen, Alaska.
Yearwood, David W. (C), U.B.O.T. Parry Lands, Pt. Fortin P. O., Trinidad, B. W. I.

(*Continued from page 514*)

Electric Welding, Arc. Heliarc Process. Production Applications for Inert Gas-Shielded Arc Welding, H. T. Herbst. Light Metal Age, vol. 5, no. 3 (Mar. 1947), pp. 14–17, 21.

Electric Welding, Arc, Subaqueous. Underwater Cutting and Welding, L. A. J. Keeble. Mech. World, vol. 121, no. 3137 (Feb. 14, 1947), p. 176.

Electric Welding, Arc, Thermodynamics. Heat Distribution Around Welding Arc, N. N. Rykalin. Engrs.' Digest (Am. Edition), vol. 4, no. 1 (Jan. 1947), pp. 16–18; see also Engrs.' Digest (Brit. Edition), vol. 8, no. 1 (Jan. 1947), pp. 22–24.

Electric Welding, Electrodes. Chemical Composition of Austenitic Welding Electrodes, R. K. Lee. Metal Progress, vol. 51, no. 3 (Mar. 1947), pp. 445–447.

Electric Welding, Power Supply. Electricity Supply for Electric Welding, R. Neumann. Engineering, vol. 162, no. 4217 (Nov. 8, 1946), p. 446.

Electric Welding, Power Supply. Power Factor Correction Is Designer's Responsibility, R. B. Giles. Elec. Mfg., vol. 38, no. 5 (Nov. 1946), pp. 144, 146.

Electric Welding, Power Supply. Three Phase Supplies of Zero Voltamperes, G. W. Stubbings. Elec. Engr. & Merchandiser, vol. 23, no. 7 (Oct. 1946), pp. 236–238.

(*Continued on page 554*)

Corrosion-Wise and Cost-Wise

Stainless-Clad Steels save money

Both cost *and* corrosion were conquered in the design of these kettles. Used in hot varnish manufacture, they were fabricated of a Lukens Clad Steel by Massachusetts Engineering Company, North Quincy, Mass.

For *any* equipment requiring high heat conductivity with the corrosion resistance of stainless, you can now hold down first cost and future costs by specifying Lukens Stainless-Clad Steel. The stainless cladding is permanently bonded in a uniform thickness to lower-cost steel, providing heat transfer properties far superior to solid stainless.

The stainless can be of any standard specification, clad in any proportion of plate thickness, from 5 to 50 per cent. Backing plate can be any quality carbon or low alloy steel.

Lukens Stainless-Clad Steels are furnished in plates from $\frac{3}{16}$″ to over 3″ thick, or in widths up to 178″. Heads in all styles and sizes can be furnished to over 18′ in diameter. There are no unusual fabrication problems.

Further information on Lukens Stainless-Clad Steels is contained in Bulletin 338; on Lukens Nickel-Clad, Inconel-Clad and Monel-Clad Steels, in Bulletin 255. Please write for copies. Lukens Steel Company, 407 Lukens Building, Coatesville, Pennsylvania.

LUKENS

Nickel-Clad Stainless-Clad
Inconel-Clad Monel-Clad
STEELS

SOLID METAL ADVANTAGES WITH CLAD-STEEL ECONOMY

(*Continued from page 552*)

Electric Welding, Power Supply. Uniform Welding Results Obtained by Equalizing Current and Pressure, M. Thomson. Steel, vol. 120, no. 11 (Mar. 17, 1947), pp. 101–102.

Electric Welding, Resistance. Automatic Welding Corrosion-Resistant Metals, R. J. Anderson and H. J. Roberts. Industry & Welding, vol. 20, no. 2 (Feb. 1947), pp. 48–50, 52, 54.

Electric Welding, Resistance. Case Histories Show Versatility of Resistance Welding, J. W. Kehoe. Matls. & Methods, vol. 25, no. 3 (Mar. 1947), pp. 77–81.

Electric Welding, Resistance. Projection Welding of Low Carbon and Stainless Steel Sheet, M. L. Ochieano. Product Eng., vol. 18, no. 3 (Mar. 1947), pp. 124–126.

Gasoline Tanks. Welded Construction of Drop-Shaped Container for Liquid Fuel. Engrs.' Digest (Am. Edition), vol. 4, no. 1 (Jan. 1947), p. 44; see also Engrs.' Digest (Brit. Edition), vol. 8, no. 1 (Jan. 1947), p. 2.

Locomotives Boilers. Alloy Steels for Welded Locomotive Boilers, H. L. Miller. Ry. Mech. Engr., vol. 121, no. 1 (Jan. 1947) pp. 6–8, 15.

Locomotive Boilers. Welded Locomotive Boilers Are Here to Stay. Welding Engr., vol. 32, no. 3 (Mar. 1947), pp. 35–38.

Magnesium Alloys. Riveting and Spotwelding Magnesium Alloys, A. G. Gray. Steel, vol. 120, no. 9 (Mar. 3, 1947), pp. 114–115, 142, 144, 146, 148, 150, 152, 154; No. 10 (Mar. 10), pp. 90–91, 114, 116, 119.

Materials Handling, Welding Shops. Efficient Handling Lowers Welding Costs. Industry & Welding, vol. 20, no. 2 (Feb. 1947), pp. 26–29, 58.

Metals, Hard Facing. You Can Profit from Flame Hardening. Industry & Welding, vol. 20, no. 3 (Mar. 1947), pp. 48–50, 52.

Metal Spraying. Production Metallizing Solves Problem of Protecting Welded Seam in Steel Barrels and Drums. Metco News, vol. 3, no. 11 (Jan. 1947), pp. 10–11.

Metal Working. Everchanging Picture in Materials and Processing Equipment, T. C. Dumond. Steel Processing, vol. 33, no. 2 (Feb. 1947), pp. 98–100.

Metal Working, Salt Baths. Materials & Methods Manual 24–Salt Baths for Metals, E. L. Cady. Matls. & Methods, vol. 25, no. 3 (Mar. 1947), pp. 99–114.

(*Continued on page 564*)

ABSTRACTS OF CURRENT WELDING PATENTS

Prepared by V. L. Oldham

Printed copies of patents may be obtained for 25¢ from the Commissioner of Patents, Washington 25, D. C.

2,417,819—APPARTUS FOR JOINING WIRES AND THE LIKE BY FUSION—Gilbert Gilliver, inventor, London, England, assignor to Standard Telephones and Cables Limited. (9 Claims)

This apparatus has a casing forming a handle, a spring-mounted carbon electrode movably positioned on the casing, a trigger lever pivotally mounted in the casing, a clamping spring associated with the lever and means for connecting an electric circuit to the electrode and clamping spring.

2,417,883—WELDING SHIELD—Samuel Oschin, inventor, Detroit, Mich. (6 Claims)

A welding shield having a special lens thereon is disclosed. The lens can be rotated to permit free passage of light rays through an opening in the shield, and a solenoid controlled by the welding circuit controls the position of the lens.

2,417,907—ELECTRIC ARC WELDING APPARATUS—Hugh S. Bowen, Sr., Fairfield, and James A. Smith, Jr., inventors, Birmingham, Ala. (4 Claims)

This patent provides at least two parallel welding circuits, a relay contact in a line of each circuit, a choke coil in shunt with each relay contact and a relay coil in each welding circuit. Each relay coil is adapted to control relay contacts in one of the other circuits than the one in which it is connected so that the choke coil in one circuit absorbs the overload in that circuit on opening another circuit.

2,418,208—GAS TORCH—George L. Walker, inventor, Jersey City, N. J., assignor to Air Reduction Company, Inc. (6 Claims)

Walker's novel gas torch includes a elongated block having a longitudinally extending recess in its face. The recess has laterally enlarged portions with a plurality of gas passage discharge orifices being formed in each enlarged portion of the recess. The total area of the orifices is substantially smaller than the area of any enlarged portion.

2,418,415—WELDER'S MASK—Wayne Leser, inventor, South Ozone Park, N. Y. (6 Claims)

This mask has a protective screen and electrically operable screen controlling means are provided therefor. Such means are controlled by an armature associated with the welding circuit so as to be operated before the welding circuit is closed.

2,418,533—GAS TORCH—George. L. Walker, inventor, Jersey City, N. J., assignor to Air Reduction Co., Inc. (2 Claims)

Walker's gas torch includes an elongated block having a longitudinally directed recess in its lower face. A series of gas passages connect to the recess while a series of nozzles are positioned in the block and extend through the recess to the lower face of the block.

2,418,631—UNDERWATER TORCH LIGHTER—David F. Geiger, inventor, Los Angeles, Calif., assignor of one half to Glenn C. True. (4 Claims)

The patented lighter has a normally closed cylindrical casing with torch lighting, spark generating means in the casing. A duct for propelling fluid under pressure from the casing is provided and a valve, opened by actuation of the spark generating means, releases a stream of the fluid into the water with the ignition sparks when they are generated.

2,418,681—ELECTRODE HOLDER—Martin Wells, inventor, Los Angeles, Calif. (12 Claims)

In this electrode holder, a body has a lateral opening for receiving a weld rod, and a special pin with an annular guard therearound is received in the body for securing the weld rod.

2,418,781—WELDING ELECTRODE—George E. Lewis, inventor, Detroit, Mich. (2 Claims)

Lewis' device covers an electrode that has a holder with a socket therein. A replaceable tip is received in the socket and adapted to be forced axially outwardly of the socket as the tip is rotated.

2,418,951—WELDING APPARATUS—Samuel Pitt, Westfield, and Daniel Vaughn Waters, Flemington, N. J., inventors, and assignors to Western Electric Co., Inc. (5 Claims).

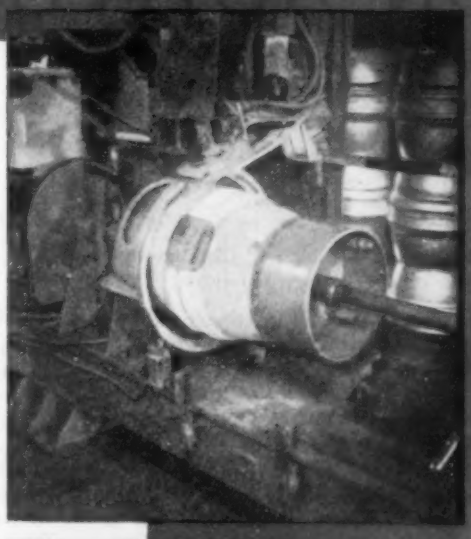
This welding apparatus includes a carriage mounted reciprocable electrode adapted to bear on an article on a support, and means movable with the electrode to apply an inflammable material to the article in advance of the electrode.

2,419,152—ELECTRICAL CONNECTOR—Karl J. Mosebach, inventor, Pittsburgh, Pa. (2 Claims)

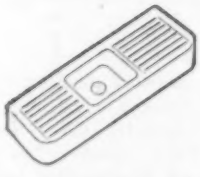
The patented connector is adapted for use as an electrode holder and includes a tubular body having special coupling and fuse positioning members therein.

Want to Build a Better BARREL? SINK? PISTON?

How INERT-ARC Welding Gave 3 Leading Manufacturers fast, fine-looking, FLUX-FREE WELDS



● Under an Inert-Arc welding head, two halves of an aluminum beer barrel are automatically joined by a smooth, circumferential seam in shops of the Aluminum Company of America. Absence of flux eliminates the necessity for after-weld cleaning—and the smooth finish of the Inert-Arc weld makes cleansing of emptied barrels easier.



● Stainless steel sinks are welded by the Inert-Arc process. The Elkay Manufacturing Company, builder of modern sinks, finds that Inert-Arc welding makes such a neat joint that grinding time is about half of that required for ordinary arc welding.

● In fabricating oil-cooled, aluminum, diesel-engine pistons, no porosity could be tolerated—deep penetration was necessary—and flux, with its problem of removal, had to be avoided. The Inert-Arc process met these requirements successfully—and the time for the operation was even less than expected.

The Inert-Arc process is by no means confined to the welding of aluminum or stainless steel. Copper, magnesium, Fernico, and other "difficult" metals are welded easily, neatly, free from oxidation, with less distortion, and *without the use of flux!*—by Inert-Arc. Write your nearest General Electric Arc-Welding Distributor for **Bulletin GEA-4704.** *Apparatus Department, General Electric Company, Schenectady 5, N. Y.*

ARC-WELDING EQUIPMENT
ELECTRODES AND ACCESSORIES

GENERAL ELECTRIC

672-84

SECTION ACTIVITIES

BOSTON

The annual meeting of the Boston Section was held at the Engineers' Club on April 7, and the following officers were elected to serve for the year 1947–48.

Chairman—H. G. Austin, Lukenweld, Inc.
Vice-Chairman—W. B. Strathdee, Westinghouse Electric Corp.
Secretary-Treas.—P. N. Rugg, Boston Edison Co.
Trustee—L. F. Jackson, The Linde Air Products Co.
Directors—P. Edward McKenna, C. F. Peterson and F. J. Purdy.

At this meeting, W. Parker, General Electric Co., showed the sound film "This Is Resistance Welding," which is part of their "More Power to America" program.

The technical speaker of the meeting was R. C. Miller, Jr., of the Thompson Laboratory, River Works, General Electric Co., Lynn, Mass. Mr. Miller spoke on the subject of "Metallizing for Production, Protection and Restoration," using slides and samples to illustrate applications of this process. Included in his talk Mr. Miller discussed the properties of sprayed metal and means of controlling quality as well as the applications.

L. F. Jackson, as chairman of a special committee, gave a preliminary report on the plans for a special program in recognition of the Twenty-Fifth Anniversary of the starting of the Boston Section. This program will probably be arranged for the October meeting.

CHICAGO

The April meeting was held on the 18th at the People's Gas Light and Coke Co. Auditorium. Dinner at Burke's Grille and Restaurant preceded the meeting. E. P. Auler, Taylor Forge and Pipe Works, spoke on "Controlled Low Temperature Stress Relieving with the Oxy-Acetylene Flame." Welding stresses, their importance and ways to reduce or eliminate them: the technical aspect and application of this relatively new method of stress relieving was presented as applied on Penstock piping. An official American League Picture "World Series of 1946" was shown before the meeting.

CINCINNATI

Frank McGuire, Jr., was the speaker at the April 22nd meeting held at Engineering Society Headquarters. Mr. McGuire's subject was "Heliarc Welding."

CLEVELAND

Newly elected officers of the Cleveland Section for 1947–48 are as follows:

Chairman—Michael S. Shane, Cleveland Electric Illuminating Co.
1st Vice-Chairman—Arthur G. Portz, Cleveland Welding Co.
2nd Vice-Chairman—Calvin J. Wyss
Secy.-Treas.—Joseph F. Wagner, Burdett Oxygen Co.

The Annual Welding Conference of the Cleveland Section was held this year at the Hollenden Hotel on Friday, May 9th.

Headlining the evening session was C. T. "Cy" Burg, Vice-President and General Sales Manager of the Iron Fireman Co., who made everyone's hair stand on end with a talk titled "Beware of the Three Bogie Men." "Cy" Burg is well known in Cleveland and throughout the country for his work in developing the automatic stoker business in which he started back in 1923. His stimulating speeches are especially well known in the Cleveland area.

Also speaking at the evening meeting was the National President of the A.W.S., L. W. Delhi, formerly vice-president in charge of ship building of Western Pipe & Steel in San Francisco.

The first afternoon paper was presented at 2:00 P.M. by O. C. Fredericks, technical supervisor of the resistance welding division of General Electric Co., Philadelphia, Pa. His topic, "New Developments and Application of Quantity Control Technique" contained a number of new and important ideas for companies now doing resistance welding.

The second afternoon paper on "Oxy-Arc Process for Cutting Materials" was given by Carl M. Schaub, sales manager in the Philadelphia territory for the Arcos Corp. Mr. Schaub, a graduate of Lehigh University, has been in the welding industry for many years, having worked for a number of years out of Cleveland with the Una Welding Co.

P. J. Patton, regional sales manager for Ransome Machinery Corp., Dunnellen, N. J., spoke from a designer's point of view on "The Development and Application of Welding Positioners and Turning Rolls," discussing how these devices can best be applied to different types of products. Mr. Patton is well known as a welding consultant. He was formerly with the Arthur G. McKee Co. in Cleveland.

Chairman of the afternoon session was J. Frank Maine of Republic Structural Iron Works and former Chairman of the Cleveland Section. Toastmaster at the dinner and evening meeting was A. E. "Al" Gibson, President of the Wellman Engineering Co. and former National President of the AMERICAN WELDING SOCIETY.

COLORADO

The April 15th meeting was held at the Blue Parrot Inn. An excellent film, "Rain Welding in the Moffat Tunnel," was shown during dinner. Orville T. Barnett, Division Engineer of the Electrode Division of Metal & Thermit Corp., was the guest speaker at the meeting. His subject was on "Welding of Hardenable Steels." Mr. Barnett was a very interesting and able speaker and while the paper was highly technical, the interest of the members and guests was very high.

COLUMBUS

The regular monthly meeting was held on April 11th at Hotel Fort Hayes. E. C. Brekelbaum, Executive Chief Engineer, Harnischfeger Corp., spoke on the subject "Coordination of Engineering and Production in the Manufacture of Welded Products"—a very interesting and instructive message to the members and guests of the Columbus Section.

At the May meeting held on the 9th, A. E. Zeisel, Assistant to the President in Charge of Sales, Eutectic Welding Alloys Corp., spoke on "New Developments in Welding at Low Heat."

DETROIT

The April meeting of the Detroit Section was held on the 11th and of the Saginaw Valley Division on the 10th. The program for these meetings consisted of an address by John D. Gordon of the Progressive Welder Co., who spoke on "Resistance Welding in the Automobile Body." Mr. Gordon's talk covered not only the scope and the important part Resistance Welding assumes in the building of an automobile today but also many other important and interesting points.

A gala crowd of 600 members and guests attended the Fourth Annual Ladies' Night at the Fort Wayne Hotel on Friday, May 2nd. Under the personal supervision of Mrs. Hazel M. Hakalow, "A Night in Las Vegas" proved to be one of the most successful "fun" nights in the history of the Detroit Section. The evening started with a sumptuous buffet supper. Immediately following, the crowd played at the various games of chance in the Temple Room. The winners were rewarded by chances on the many door prizes donated by local suppliers.

Several acts from local night spots provided entertainment and beer and punch

9 pounds of Ni-Rod saved this $150 iron casting

After this iron pipe guide barrel had been cast, the foundry discovered that the pattern had been made too small on four projections.

The damage was done... *but not permanently*. For the foundry was able to do a perfect build-up job with Ni-Rod.*

Each of the 4 areas shown in the accompanying sketch were ground down in preparation for the welding. Then, using 5/32" electrodes, Ni-Rod was deposited at 130 amps, d.c., reversed polarity. Seven passes were made to build up 3 layers. After welding, the deposits were peened and machined to the correct over-all dimension of 22" + 0.000" − 0.032".

No preheat was necessary.

Said the welder, *"Ni-Rod is the best rod I ever used on cast iron."*

* * * * *

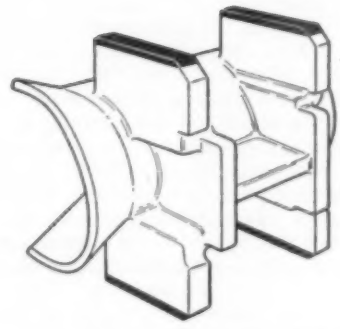
Money-saving repairs and enthusiastic comments like this are typical of Ni-Rod.

Why?

Because smooth-handling Ni-Rod gives you *strong* welds... *sound* welds... *machinable* welds... and usually *without* pre-heating.

If you haven't tried Ni-Rod, order a package today. Rods come in 3/32", 1/8", 5/32" and 3/16" diameters. There'll be plenty of times when you can use Ni-Rod for quick, easy and money-saving repairs on defective castings. *Reg. U. S. Pat. Off.

THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street, New York 5, N. Y.



WHERE THEY BUILT UP THE CASTING WITH NI-ROD

Each of the 4 darkened projections was ¼" too short. By building up the undersize areas with only 9 pounds of Ni-Rod, an otherwise perfect casting (worth $150) was saved. Over-all length and height: 28" x 22". Weight: 300 lbs. Area of repair: 2" x 10".

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NI-ROD IS DISTRIBUTED BY:

WHITEHEAD METAL PRODUCTS COMPANY, INC.
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EAGLE METALS COMPANY
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ALLOY METAL SALES, LTD.
WILKINSON COMPANY, LTD.
METAL & THERMIT CORPORATION
HOLLUP CORPORATION
NATIONAL CYLINDER GAS COMPANY

were on tap at all times through the courtesy of the Patrons Committee.

The Fourth Annual Welding Conference was held on May 9th at the Engineering Society of Detroit. This was the last regular meeting of the year.

Speakers were V. E. Mathews of The Linde Air Products Co., whose subject was "Powder Cutting and Scarfing," and P. S. Doyen, Welding Equipment and Supply Co., whose subject was "Tool and Die Welding." Two technical movies were shown as follows: "A Keener Blade," shown through the courtesy of the Air Reduction Sales Co., and "Design for Arc Welded Structures," shown through the courtesy of The Lincoln Electric Co.

HARTFORD

The April 17th meeting was held at the University Club of Hartford. A. M. Setapen, Manager of Engineering Division, Handy & Harman, New York, addressed the meeting on the subject "Low Temperature Silver Alloy Brazing."

INDIANA

The April meeting was held on the 25th at the Elks Club, Seymour, Ind. J. R. Wirt, Welding Engineer, Delco-Remy Div., GMC, Anderson, Ind., was the speaker. His subject was "Development of Production Welding Techniques."

For the benefit of those interested in seeing an ideal setup of a production plant, the North Plant of Noblitt-Sparks at Seymour was opened until 6 P.M. William G. Morgan was on hand to greet members and friends of the Indiana Section and showed them through the plant.

MAHONING VALLEY

A joint meeting with the A.S.M. was held on Tuesday, April 8th, at the Mahoning Country Club, Girard, Ohio. Coffee talk was made by F. A. Bodenheim and was very well received.

Leon C. Bibber, Senior Welding Metallurgist, Carnegie-Illinois Steel Corp., addressed the group on "The Various Welding Processes and Their Relation to Each Other." Mr. Bibber was formerly Senior Welding Engineer for the Bureau of Construction and Repair, Navy Department. His work now involves the welding of all types of steel by all the various processes.

MARYLAND

The regular monthly meeting of the Maryland Section for April was held on the 18th at the Baltimore Engineers' Club Dinner preceded the meeting. The entertainment period featured a timely talk by J. L. Stanton, Aviation Director of the Baltimore Association of Commerce, on "Aviation in Baltimore."

H. F. Merchant, Welding Engineer, Progressive Welder Co., Jenkintown, Pa., presented an interesting talk entitled, "Designing for Resistance Welding." Mr. Merchant's talk provoked considerable discussion and his knack for making quick, clear isometric drawings on the blackboard to illustrate various designs made his talk quite clear cut.

MICHIANA

Over 100 members and guests of the Michiana Section spent a very profitable evening on Friday, April 18th, making a tour of the Clark Equipment Co., Buchanan, Mich. Emphasis, of course, was laid on the welding processes, of which Clark uses many. In the construction of the "banjo" rear axle housing, the following are some of the type of welding observed: multi-arc, automatic atomic hydrogen, flash butt, unionmelt submerged arc for welding the O.D. of the reinforcing ring to the "banjo," automatic electric arc to weld brake flanges to the housings.

Souvenir "programs" listing the 6 types of welding used and giving the vital statistics of each operation, were provided each visitor.

Many thanks are due to C. H. King for making the arrangements, and to William Morganthau, Paul Scheil and Roy Burke for acting as guides.

LEHIGH VALLEY

The Lehigh Valley Section held its Annual Meeting and Ladies' Night on Monday, May 5th, at the Hotel Bethlehem, Bethlehem, Pa.

J. R. Fairhurst introduced the guest speaker, Miss Bertha Lawrence, Dean of the New Jersey State Teachers College, Trenton, N. J. Miss Lawrence presented an address on "Present Demands on Our Educational System." Because of her vast experience in the teaching profession, she was able to give a very interesting and informative presentation. Miss Lawrence told of the need for a better understanding among the peoples of the world; this goal being reached only by a high standard of education.

Refreshments and dancing followed, with the members and their ladies having a very enjoyable time.

MILWAUKEE

The regular meeting of the Milwaukee Section was held on April 25th at the Ambassador Hotel. After-dinner program consisted of a movie entitled, "The Golden Jubilee of the Automotive Industry, Held in Detroit in 1946."

The speaker of the evening was John Grodrian, Chief Metallurgist and Director of Factory Laboratory, Bendix Products Division of Bendix Aviation Corp., South Bend, Ind. "Weldability and Metallurgy of Welding," was Mr. Grodrian's subject.

NEW YORK

The April meeting of the New York Section was held in the Engineering Societies Building on April 9th. Speaker of the evening was C. W. Briggs, Technical and Research Director, Steel Founders Society of America, Cleveland, Ohio.

Mr. Briggs' talk was divided into three parts: Repair Welding, The Cast-Weld Method and Composite Fabrication.

Under the heating of repair welding, Mr. Briggs discussed the methods of preparing the casting for repair, preheating, welding techniques, post-treatment and weld finishing. In discussing the cast-weld method, Mr. Briggs showed how the use of two or more relatively small simple steel castings jointed by welding frequently is more efficient and more economical than a single large steel casting. In discussing the third point, Mr. Briggs showed many examples in which steel castings had been combined with wrought or rolled pieces to form a particular weldment. Mr. Briggs' talk was interesting and instructive and prompted many questions from the audience.

The technical chairman for the meeting was E. W. Moles, Process Service Representative, The Linde Air Products Co., New York.

NORTHERN NEW YORK

At the March 27th dinner meeting held at the Mohawk Hotel, Schenectady, the following officers were elected for the 1947–48 season.

Chairman—E. N. Boswell
1st Vice-Chairman—W. L. Immer
2nd Vice-Chairman—C. M. Rhoades, Jr.
Secretary-Treasurer—L. C. Pierson
Executive Committee—G. W. Garman, H. D. Jacobs

The technical meeting was addressed by F. Lee, International Harvester, and F. Woodward, Progressive Welder Co., on the subject "Spot Welding of Heavy Low-Alloy Steel."

NORTHWEST

On April 10th, 215 members and guests met at 5:30 in the afternoon for a tour through Paper Calmenson and Co.'s, St. Paul, Minn., new steel warehouse and fabricating plant. The visitors saw in operation the latest equipment for cutting, punching and welding of all types as well as methods they use for handling steel in their warehouse. Following the trip through the plant, the visitors were guests of the company at a dinner and after the dinner the State of Minnesota Conservation Department gave an interesting discussion and showed a movie on Minnesota Wild Life.

NORTHWESTERN PENNSYLVANIA

The final technological meeting of this Section this season took place Thursday, April 24th, at the Y.W.C.A in Warren, Pa. This was a joint meeting with the local section of the American Society of Metals and one of the largest gatherings of the year.

The guest speaker at the meeting was Dr. A. B. Kinzel, Vice-President, Electro Metallurgical Co. and Union Carbide and Carbon Research Labs., Inc. Dr. Kinzel's subject was "The Trend in Making, Shaping and Treating of Alloy Steels, with Special Emphasis on the Stainless Steels."

PHILADELPHIA

The regular monthly meeting was held on April 21st at the Engineers' Club, Dr. A. B. Kinzel, Union Carbide and Carbon Research Laboratories, presented an address on "Weldability." Two hundred members and guests enjoyed this excellent address.

The Seventh Panel Discussion Group Meeting was held on Friday, May 2nd, in the Engineers' Club Junior Room. H. W. Lawson of Schacht Steel Construction, Inc., was the speaker. His subject was "Weld Stresses in Design." Mr. Lawson has been associated with the design of welded construction for a great many years. Mr. Lawson presented certain of the fundamentals in structural design and very ably handled the discussion and questions from the audience.

PITTSBURGH

The Tenth Annual Tri-State Welding Conference sponsored by the Pittsburgh Section of the A.W.S. and the Engineers Society of Western Pennsylvania was held on the afternoon and evening of Friday, April 25th. The technical session and visitation started at 2:30 P.M., in the Auditorium of the Mellon Institute of Industrial Research. Dinner, entertainment and dancing was at 7:00 P.M. in the Imperial Room of the Hotel Webster Hall.

S. V. Williams of the Struthers-Wells-Titusville Corp. was Chairman of the Technical Session. Speaker was C. M. Underwood, Manager, Weldment Dept., Northern Ordnance Inc., Minneapolis, Minn. Mr. Underwood's subject was "Production Welding Practices." Mr. Underwood's paper covered shop operations in production of gun mounts, machine bases and functional equipment for commercial applications.

The second speaker was Julius Heuschkel, Research Engineer, Westinghouse Electric Corp., East Pittsburgh, Pa. Mr. Heuschkel's paper "Understanding—The Product of Research," dealt with original experimental data illustrating the reasons for various fusion and resistance welding phenomena.

Following the presentation of papers and discussions, an opportunity for the members, their ladies and guests to inspect the facilities of the Institute was had under the personal supervision and guidance of Vice-Chairman H. P. Schane and his associates.

A cordial invitation to attend this conference and take part in the discussions was extended to plant executives, engineers and others in the Tri-State Area interested in the application of welding in the metal working industries.

G. O. Hoglund of the Aluminum Co. was Chairman of the Dinner. In addition to his duties as Master of Ceremonies "Bob" Prince gave an entertaining talk covering interesting sidelights witnessed by a sports reporter. A few remarks were also made by George S. Baton, President, Engineers Society of Western Pennsylvania, and L. M. Dalcher, Technical Secretary of the A.W.S.

PUGET SOUND

A joint meeting with the Seattle Chapter of the A.S.M.E. was held on Tuesday, April 8th, at the Washington Athletic Club. There were over 100 people attending the meeting.

LaMotte Grover, Welding Engineer for the Air Reduction Sales Co., N. Y., gave a very instructive talk on "Design for Welding," bringing out points which would specifically interest the mechanical engineers. A series of slides were shown along with the talk and the latest types of welded structures depicted, such as various highway bridges and all-welded office buildings. Various illustrations and explanations were given from Mr. Grover's recently published "Manual of Design for Arc-welded Steel Structures." Active discussion for forty-five minutes ensured after the talk.

SAINT LOUIS

William G. Boese was the guest speaker at the April 11th meeting. Mr. Boese delivered an excellent talk on the subject of freight car manufacturing. His talk emphasized the preponderance of the welding employed. Mr. Boese predicted an all-welded box car within the next few months. Not just a special car but a production run. The meeting was followed by an informal buffet lunch. Approximately 100 members and guests attended.

SOUTH TEXAS

Karl Luger of K. E. Luger Steel Co., Houston, was the speaker and master of ceremonies at a meeting held on May 2nd in the Taylor School Auditorium. Mr. Luger's subject was "Properties and Problems in the Fabrication and Use of Stainless Steels." Mr. Luger has had a wide experience in production, fabrication and use of stainless steels, and did an excellent job in discussing the subject. Mr. Luger used the first part of the period to discuss various types of stainless materials, factors contributing to corrosive conditions, and some problems involved in shop fabrication and welding. A general discussion with questions from the floor followed Mr. Luger's remarks and continued for more than an hour with many of the members participating.

SYRACUSE

The regular monthly meeting was held on April 9th in the Syracuse Hotel. Fred L. Plummer, Chief Welding Engineer, Hammond Iron Works, presented an address on "Welded Field Erected Pressure and Variable Volume Tanks." Mr. Plummer's talk was illustrated with slides and was very well received. A film on flame cutting was shown by the Canadian Liquid Air Co.

WESTERN MASSACHUSETTS

A dinner meeting was held on April 8th at the Sheraton Hotel, Springfield, Mass. Robert C. Miller, Jr., Thompson Lab., General Electric Co., addressed the meeting on "Metallizing for Production, Protection and Restoration."

WESTERN MICHIGAN

A very excellent meeting was held on Monday evening, April 28th, in the Association of Commerce Cafeteria. Warren Sykes, Chief Electrical Engineer, Miller Electric Co., Appleton, Wis., spoke on "Power Requirements for A.-C. Welders." Based on the question period which became rather lengthy, those present were highly pleased with this rather technical program.

WESTERN NEW YORK

The April meeting was held at the Hotel Touraine, Buffalo, N. Y., on the 24th. The officers for the coming year were announced as follows:

Chairman—Clarence E. Jackson, Union Carbide and Carbon Research Labs., Inc.
Vice-Chairman—Ogden Mills, Mills Welding Supply Co.
Secretary—J. Diebold, Rudolph Wurlitzer Co.
Treasurer—R. Siemer
Directors—Charles Jennings, Richard Lyall, I. Morrison, P. Gardner and E. L. Frost

The speaker of the evening was T. B. Jefferson, Editor of *The Welding Engineer*, Chicago. Mr. Jefferson spoke on "What the Future Holds for Welding." High points of his talk included a discussion of welding vs. riveting, and the necessity for educating young engineers in the design of welded structures as well as riveted structures.

The Mills Welding Supply Co. presented a film "Distortion in Welding," which was produced by The Lincoln Electric Co. After the formal program, a lively discussion period followed.

WORCESTER

Annual meeting of the Worcester Section was held on April 8th. Officers elected for the ensuing year are as follows:

Chairman—John F. Sloan, Haynes Welding Corp.
Vice-Chairman—James L. Forand, Pullman Standard Car Mfg. Co.
Secretary-Treasurer—Robert G. Jamieson, Gaychrome Co.
Program Committee—Ernest N. Adams, American Institute of Steel Construction
Membership Committee—C. Myron Burnett, The Lincoln Electric Co.
Directors—Jack W. Bramley, Juliann C. Swann and W. L. Walker.

YORK-CENTRAL PENNSYLVANIA

Annual Ladies' Night, an informal dinner and dance, was held on Wednesday evening, April 16th, at the Out Door Club, York, Pa. Roy Gibbons and his Orchestra furnished the music for dancing. Card playing was enjoyed by those who did not dance.

Permission was granted by the U. S. Navy Department for the Section to visit

(*Continued on page 564*)

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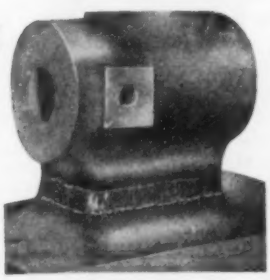

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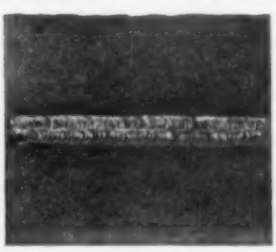

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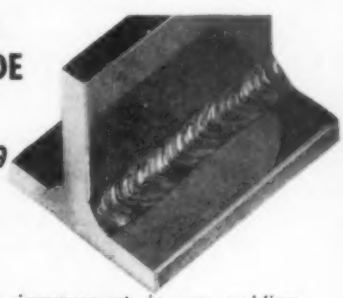

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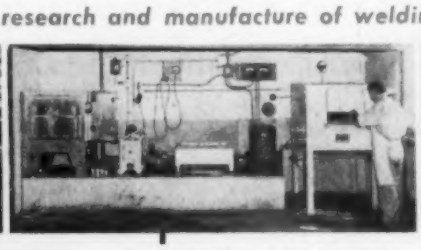

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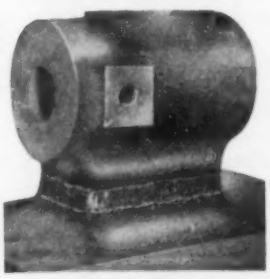

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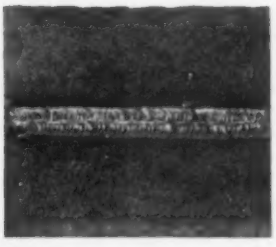

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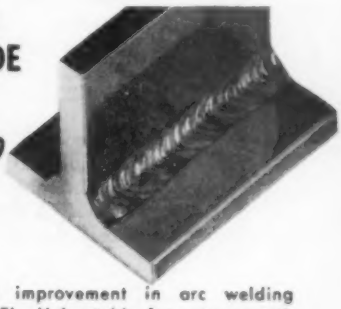

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(*Continued from page 559*)

the Naval Ordnance Plant in York, Pa., on Wednesday, May 7th. After the plant visit, members proceeded to the Pine Tree Inn for dinner.

CANADIAN

Final meeting of the 1946–47 series of the Hamilton Chapter was held on May 6th at Greene's Hotel. R. H. Davies, Consulting Engineer, Lincoln Electric Co., Cleveland, Ohio, spoke on "Designing for Welding."

Employment Service Bulletin

POSITION VACANT

V-207. Traveling Demonstrators. Lifetime opportunity for men (25 to 35 years) free to travel, to become affiliated with a well-known national organization to demonstrate and consult on electrodes and welding rods. Experience and thorough knowledge of all welding processes and brazing required. Good health and vision necessary. At least two years sales experience essential (any field). At least high-school graduate, although special college courses desirable. Mail complete hand-written résumé, mentioning salary earned, to Box V-207.

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60 YEARS WITH MEN AND MACHINES

60 Years with Men and Machines, was written by Fred H. Colvin, in collaboration with D. J. Duffin.

Fred Colvin is a true pioneer of the modern industrial revolution. He has spent a lifetime in the field of machinery, where his vision and imagination have been responsible for many improvements. His book is not, therefore, an autobiography in the strict sense of the word, but an absorbing, and oftentimes highly amusing, account of the world of invention machinery, and production from 1884 to the present day. During this span, Mr. Colvin has participated in the development of the bicycle, the automobile, the airplane and the modern railroad locomotive, as well as hundreds of new machines and machine tools. He has known intimately many of the great inventors, scientists engineers and industrialists; and he has witnessed the growth of many of our nationally known scientific and industrial societies.

Mr. Colvin has written more than 40 technical books that have sold over a million copies to date. He served as an editor of the *American Machinist* for more than 30 years, and although now formally retired, still contributes to its pages. His interests, however, extend beyond the field of machine tools into the problems of management, labor relations and the plain common sense of running a business or a shop.

Men who have had a part in the development of machinery and machine tools, or who are entering the field or are in current contact with it, will find *Sixty Years with Men and Machines* of special interest. Yet it is not confined to these groups of people; the general reader will find it an engrossing account of a unique personality and a rich period of our industrial history.

Sixty illustrations in line and halftone. Published by McGraw-Hill Book Co., Inc., New York 18. Price, $3.50.

ACETYLENE GENERATOR AND MANIFOLD CATALOG

Air Reduction has announced a new 2[illegible] page, dual purpose catalog which lists and explains the complete line of Airco acetylene generators, both stationary and portable. In clear, concise language it outlines the advantages of each. The stationary acetylene generators covered are the 300-lb. both single and double rated and the 500-lb. double rated. The portable acetylene generators range in size from 15 to 50 lb.

Then, after devoting a page to general information about National Carbide, the catalog goes on to Airco Manifolds both oxygen and acetylene. Oxygen manifolds covered include both the Duplex-type, designed for use with two individual banks of cylinders and the Simplex-type accommodating a single bank of cylinders. Also described are stationary-type acetylene manifolds and Duplex-type manifolds for hydrogen and other gases. Portable manifolds for both oxygen and acetylene are covered in detail. The oxygen portable manifold information is also applicable to other gases including carbon dioxide.

One of the features of this attractive two-color catalog is the three pages devoted to diagrams which illustrate typical manifold installations and show their flexibility and adaptability.

The last two pages are devoted to gas control and safety devices for pipe lines such as station outlet valves and flashback arresters.

(*Continued from page 554*)

Natural Gas Pipe Lines, Texas-California. Ultra-modern Fabrication for Biggest Inch, R. Sneddon. Petroleum Engr., vol. 18, no. 6 (Mar. 1947), pp. 134, 136, 139, 142, 144; see also brief item in Gas, vol. 23, no. 2 (Feb. 1947), p. 44.

Ordnance. Welding Military Equipment in Britain, E. D. Lacy. Welding Engr., vol. 32, no. 3 (Mar. 1947), pp. 57–59.

Oxyacetylene Welding, Forge. Oxyacetylene Pressure Welding as It Affects Design, R. A. Kubli. Product Eng., vol. 18, no. 3 (Mar. 1947), pp. 117–121.

Oxy-Gas Cutting. City Gas and Oxygen Mixture Effective in Flame Cutting Steel. Steel, vol. 120, no. 12 (Mar. 24, 1947), p. 77.

Oxygen Cutting. New Combination Oxygen-Arc Cutting Process. Industry & Welding, vol. 20, no. 1 (Jan. 1947), pp. 48, 50, 62.

Oxygen Cutting, Stainless Steel. Flame Cutting Stainless Steel. Industry & Welding, vol. 20, no. 1 (Jan. 1947), pp. 54, 56.

Oxygen Cutting, Stainless Steel. Powder Cutting of High Alloys, D. H. Fleming, Jr. Matls. & Methods, vol. 25, no. 2 (Feb. 1947), pp. 73–76.

Penstocks, Welded Steel. Welding of Penstocks at Cobb River, A. W. Grainger. New Zealand Eng., vol. 11, no. 1 (Jan. 1947), pp. 65–69.

Petroleum Pipe Lines, Maintenance and Repair. Pigs Seal Pipe Ends During Cutting Operations, P. Reed. Oil & Gas J., vol. 45, no. 47 (Mar. 29, 1947), pp. 143–144.

Pipe Lines Play Big Role in Nation's Economic Reconversion, R. H. Davies. Petroleum Engr., vol. 18, no. 6 (Mar. 1947), pp. 182, 184, 186.

Radio Transmission, Pulse Time Modulation. Multiplexing by Pulse-Time Modulation. Elec. Mfg., vol. 38, no. 4 (Oct. 1946), pp. 152, 154.

Soldering, Electric. Induction Soldering Speeds Kitchen Utensil Production, L. Gise and J. R. Stewart. Steel Processing, vol. 38, no. 2 (Feb. 1947), pp. 101–102.

Stainless Steel. Tooling for Fabrication of Stainless Steel. J. C. Whitesell. Steel Processing, vol. 33, no. 2 (Feb. 1947), pp. 85–89, 112; see also Tool Engr., vol. 18, no. 2 (Mar. 1947), pp. 18–22.

Steel Plates, Edge Preparation. Flame-Cutting Plates for Welded Ships, M. Forman. Welding Engr., vol. 32, no. 3 (Mar. 1947), pp. 53–56.

Theaters, Repair. Earthquake Repairs to Theatre, C. Lievien. New Zealand Eng., vol. 11, no. 1 (Jan. 1947), pp. 71–72.

Toolroom Practice. Case for Fundamentals, E. H. Wheeler. Tool Engr., vol. 18, no. 2 (Mar. 1947), pp. 40–41.

Water Pipe Lines, Cold Water Problems. Thawing Frozen Water Pipes with Arc-Welding Units, R. F. Wyer. Ry. Eng. & Maintenance, vol. 42, no. 12 (Dec. 1946), pp. 1297, 1305.

Water Pipe Lines, Cold Weather Problems. Thawing Water Lines, R. F. Wyer. Industry & Welding, vol. 20, no. 2 (Feb. 1947), pp. 46, 68–69.

Water Pipe Lines, Cold Weather Problems. Thawing Ice out of Pipes, R. F. Wyer. Mill & Factory, vol. 40, no. 2 (Feb. 1947), p. 113.

Water Tanks and Towers. Build New 750,000-Gallon Water Tank at Hamilton. Eng. & Contract. Rec., vol. 60, no. 4 (Mar. 1947), pp. 98, 100.

Welding Codes. Why Not More Structural Welding? Industry & Welding, vol. 20, no. 3 (Mar. 1947), pp. 29–31, 85–87.

Welding. Innovations for Faster Welding, W. P. Brotherton. Mill & Factory, vol. 40, no. 3 (Mar. 1947), pp. 118–121.

Welding Research. Position of Welding Research. Engineering, vol. 162, no. 4222 (Dec. 13, 1946), p. 566.

Welds, Defects. Snow Flakes and Hairline Cracks in Weld Metal, M. Lefevre. Engrs.' Digest (Am. Edition), vol. 4, no. 3 (Mar. 1947), pp. 131–135; see also Engrs.' Digest (Brit. Edition), vol. 8, no. 3 (Mar. 1947), pp. 95–99.

Welds, Design. Materials & Methods Manual 23—Weldments, E. L. Cady. Matls. & Methods, vol. 25, no. 2 (Feb. 1947), pp. 101–116.